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WAR MACHINE

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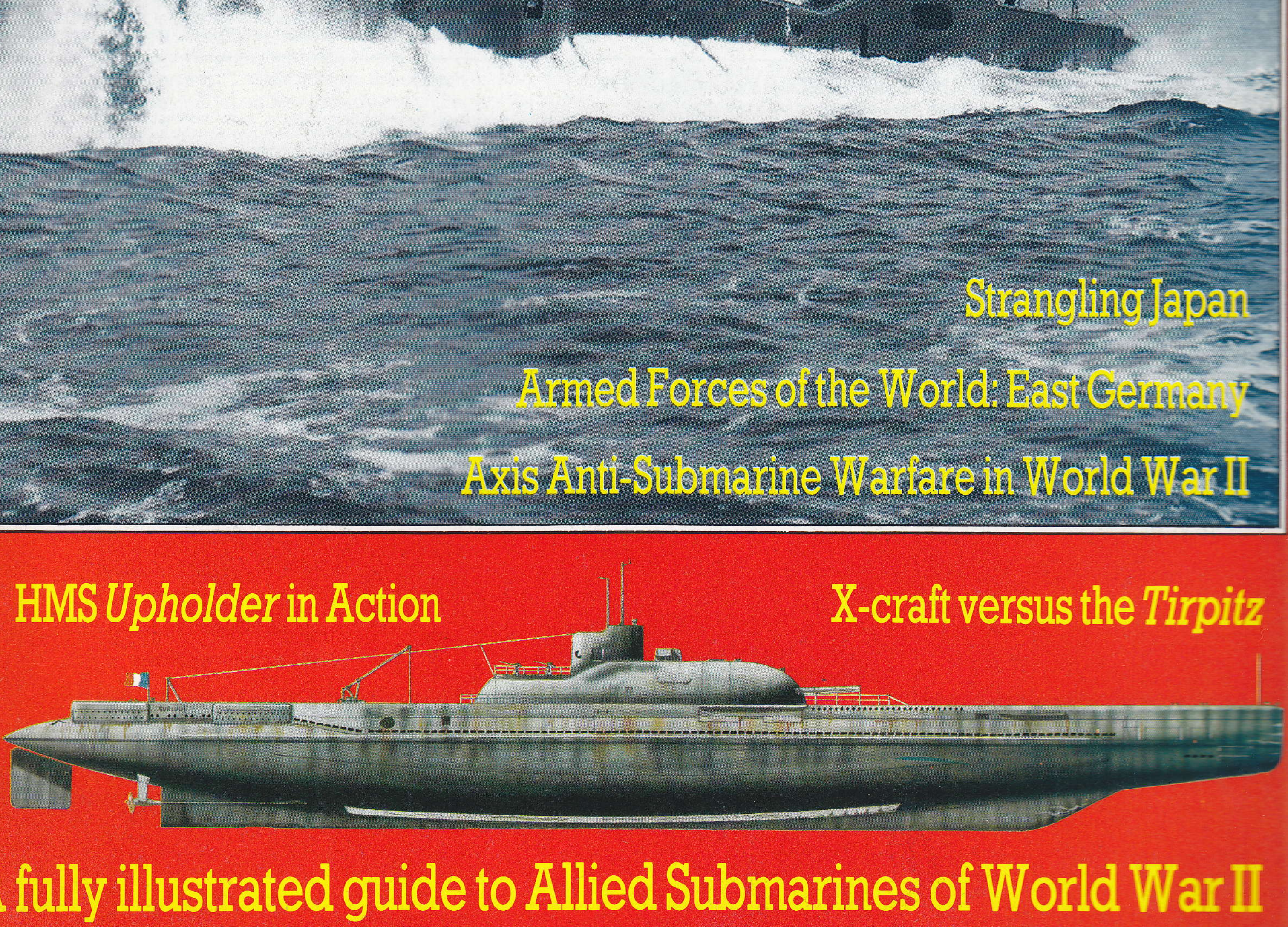
Axis Anti-Submarine Warfare in World War II

HMS *Upholder* in Action

X-craft versus the *Tirpitz*



A fully illustrated guide to Allied Submarines of World War II

WAR MACHINE

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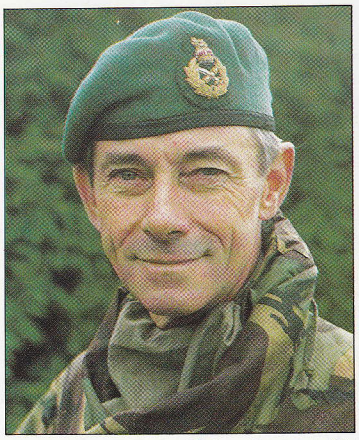

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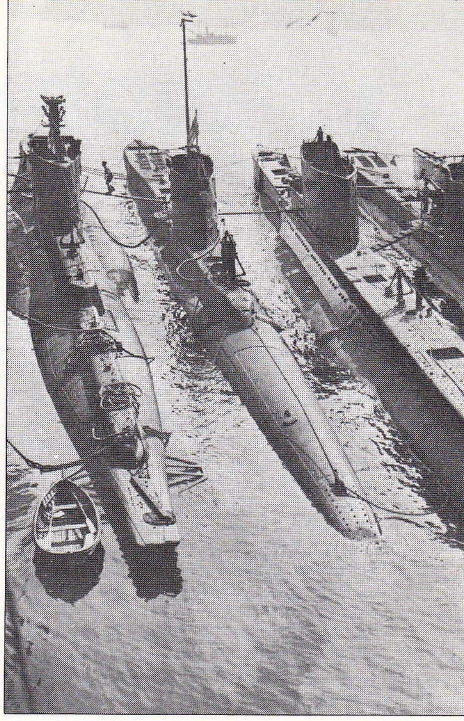
Allied Submarines of World War II

While not achieving the notoriety of the German 'wolf packs', Allied submarine forces nonetheless made significant contributions to the war effort. In Europe they were active from Norway to the Mediterranean, and in the Far East the collapse of the Japanese economy in the last years of the war was largely due to the US submarine blockade.

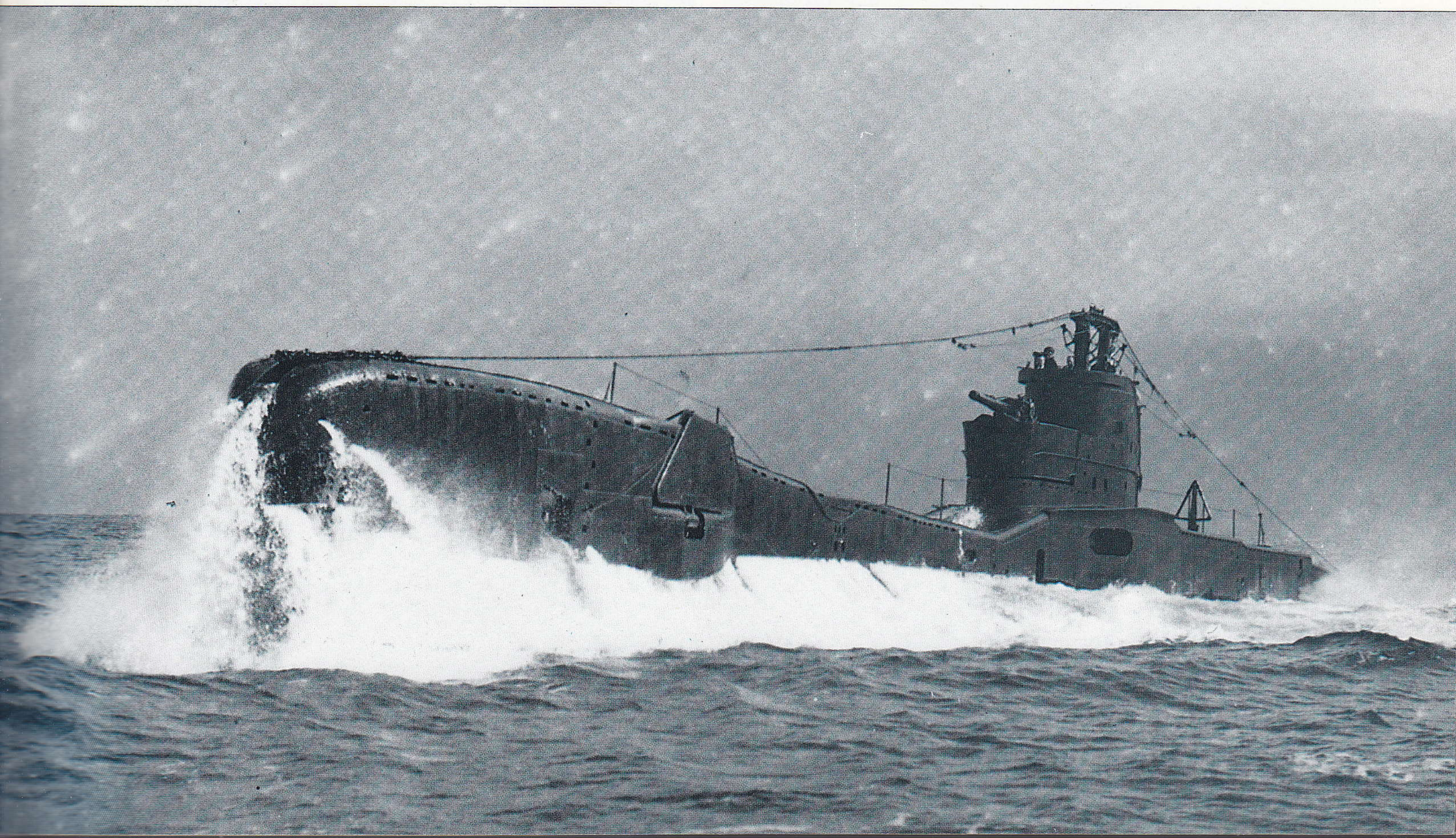


A British submarine flotilla nestles alongside its depot ship. HMS Upright*, second from the right, had the unusual distinction of including a floating dock and an aircraft amongst her victims.*

Submarines sighted in the Atlantic during World War II were, very likely, those of the Germans, for the area was largely devoid of targets for Allied boats. The British, reinforced by such submarines as were able to escape their various countries' rapid collapse, concentrated their efforts in European waters, where the Axis had to risk surface movement. Thus, submarine attack was used effectively in the Norwegian campaign, against transitting U-boats and in the long struggle in the Mediterranean. Shortage of boats, as in everything else, obliged the British initially to a virtual denuding of the Far East of larger submarines for use in constricted waters where they were both unsatisfactory and vulnerable. When, eventually, the Far East itself was engulfed in war, the British submarine presence was minimal, many of the diverted boats having been lost. Only with the Mediterranean sea war effectively coming to an end with the surrender of enemy forces in North Africa could the Royal Navy redeploy its improved 'T' class boats to the eastern theatre, where the submarine war against Japan was already dominated by the Americans.

The position of the American submarine arm vis-à-vis the Japanese mercantile marine was analogous to that between the Germans and the British. Both maritime-based empires depended upon their seaborne trade; if this could be throttled the empire would inevitably collapse. Because the experienced British were prepared, they survived the onslaught (albeit narrowly), but the Japanese were wide open and blinkered to the truth of their shortcomings. The American skipper proved to be determined, adaptable and highly innovative, devising original and bold attack techniques. His fleet organization gave him full backing with temporary advanced bases and tenders used to the full to follow the war's advance, shortening transit times and maximizing time on patrol.

HMS Taku *makes her way at close to her maximum surface speed of 15 kts. The British 'T' class was larger than most Royal Navy boats, and hence more suited to the Far East campaign. Such was the need for boats closer to home that even these large craft were used in European waters.*



FRANCE

'Saphir' class

Like the Royal Navy, the French had a six-strong class of minelaying submarines, the **'Saphir' class** of 1925-9. These were much smaller than the British boats, being geared to Mediterranean operations. Again, as a mine capable of being launched through a standard torpedo tube had not been developed, the hull design was dominated by the mine stowage. The design for this had been produced by the well-known submarine builder, Normand, but was based on that of the British 'E' class minelayers of 1914-8: 16 vertical chutes were built into the space between the widely-separated double hulls, in four groups of four, and each chute could accommodate two mines, though a weakness of the arrangement was that these were of special manufacture. The British had abandoned the system in favour of laying over the stern with the mines stowed within the upper casing.

Four stretched versions, continuing the 'jewel' names as the **'Emeraude' class**, were scheduled to follow in 1937-8. Lengthened by nearly 7 m (22.97 ft), they would have carried 25 per cent more mines, but only the nameship was ever laid down and she was destroyed on the slip at the occupation.

Of the 'Saphirs', three (***Nautilus, Saphir*** and ***Turquoise***) were taken by the enemy at Bizerta and one (***Le Diamant***) was scuttled at Toulon. The ***Rubis*** and ***Perle*** operated for the duration of the war (the latter was sunk in error by British aircraft in July 1944) under the Free French flag. The *Rubis* began operating with the British Home Fleet in April 1940, laying mines in Norwegian waters. Between then and the end of 1944 she carried out no less than 22 successful minelaying operations, most to interrupt the enemy's coast-hugging mercantile routes. The total of 15 ships known to have been destroyed on her mines included several Scandinavians carrying German ore cargoes, a minesweeper and four small anti-submarine vessels. She also torpedoed and sank one more, a Finn.

Specification

'Saphir' class

Displacement: 761 tons surfaced and 925 tons submerged

Dimensions: length 65.90 m (216.21 ft); beam 7.12 m (23.36 ft); draught 4.30 m (14.11 ft)

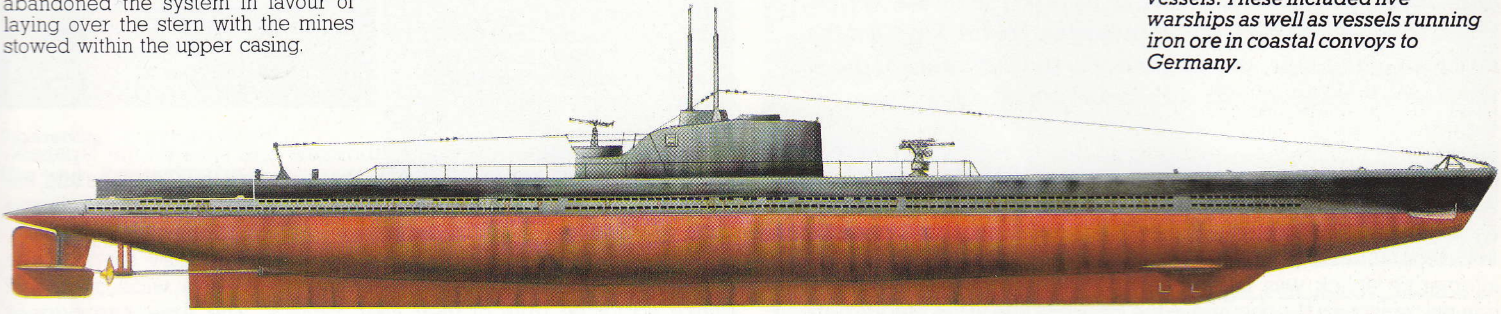
Propulsion: two diesels delivering 969.4 kW (1,300 bhp) and two electric motors delivering 820.3 kW (1,100 hp) to two shafts

Speed: 12 kts surfaced and 9 kts submerged

Endurance: 12970 km (8,059 miles) at 7.5 kts surfaced and 148 km (92 miles) at 4 kts submerged

Armament: one 75-mm (2.95-in) gun, three 550-mm (21.65-in) torpedo tubes (two bow and one stern), two 400-mm (15.75-in) torpedo tubes in a trainable mounting, and 32 mines

Complement: 42



The most successful minelaying submarine of the war,* Rubis *was responsible in her 22 minelaying patrols for the sinking of at least 15 vessels. These included five warships as well as vessels running iron ore in coastal convoys to Germany.

FRANCE

'Surcouf' class

Most of the major maritime nations at sometime or other experimented with the idea of the cruiser submarine. All were larger than usual, with an exceptional surface armament and good endurance. Some carried an aircraft to increase their effective search radius. The only design to combine, reasonably successfully, all these features in one hull was the ***Surcouf***. Ordered under the 1926 programme as the first in a class of three, she was destined to be the only unit of the **'Surcouf' class**, and the largest submarine in the world in terms of displacement, though shorter than both the American 'Narwhal' and the Japanese 'A' boats.

At the time of the Washington Treaty the British *M1* to *M3* had 304.8-mm (12-in) guns and, to prevent further escalation in this direction (though even these were overlarge and totally unwieldy) the treaty limited future submarines to 203.2-mm (8-in) weapons. Only the French ever fitted the latter, and these to the *Surcouf*, paired in a complex pressure-tight turret. This structure was faired into a pressure-tight 'hangar' abaft it and containing a specially-designed Besson M.B.411 floatplane. This had to be taken out and the wings attached before it could be lowered into the water, a time-consuming and highly risky business which, while acceptable in 1926, was certainly not in 1939-45. Only the French could ever have specified the torpedo tube fit. This comprised four 550-mm (21.65-in) tubes set in an orthodox bow arrangement, with six reloads; one quadruple 550-mm trainable mounting in the casing threequarters aft; and a quadruple 400-mm (15.75-in) trainable mounting in the casing right aft, with four reloads.

The suggested mode of operation of submarines such as these was always rather woolly and the *Surcouf*, like the rest of her kind, was never to find a proper role. Seized in Plymouth in July 1940, she was operated by a Free French crew on several Atlantic patrols. In December 1941 she participated with three French corvettes in the seizure of the Vichy islands of St Pierre and Miquelon, in the St Lawrence estuary. In February 1942 she sank in the Caribbean after a collision.

Specification

'Surcouf' class

Displacement: 3,270 tons surfaced and 4,250 tons submerged

Dimensions: length 110.00 m (360.89 ft); beam 9.00 m (29.53 ft); draught 9.07 m (29.76 ft)

Propulsion: two diesels delivering 5667.3 kW (7,600 bhp) and two electric motors delivering 2535.4 kW (3,400 hp) to two shafts

Speed: 18 kts surfaced and 8.5 kts submerged

Endurance: 18531 km (11,515 miles) at 10 kts surfaced and 111 km (69 miles) at 5 kts submerged

Armament: two 203.2-mm (8-in) guns, two 37-mm guns, eight 550-mm (21.65-in) torpedo tubes (four bow and four in a trainable mounting), and four 400-mm (15.75-in) torpedo tubes (in a trainable mounting aft)

Complement: 118

Surcouf*, *seen here in the Clyde estuary, was a product of the inter-war concept of the 'cruiser submarine', espoused by many navies. She was the closest of all such designs to being a success, without ever having the chance to be employed against enemy merchant shipping.

Axis Anti-Submarine Warfare in World War II

Of the Axis powers only Italy had devoted any serious effort to anti-submarine warfare, and so Allied submarines were to face tough opposition in the Mediterranean. By contrast, German and Japanese ASW preparation was weak and Japan's maritime empire was to pay dearly for this error.

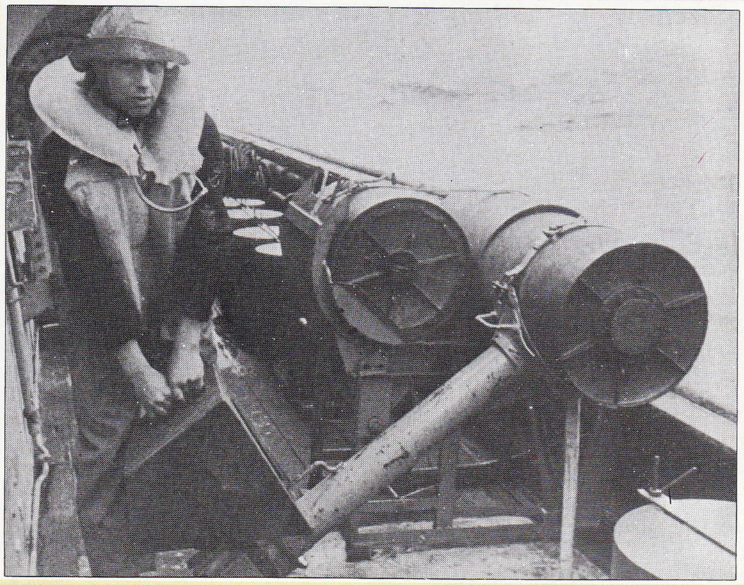
It was fortunate for the Allies that the major enemy powers had not put as much effort into their prewar ASW preparations as into their submarine arms. As far as the British (at least) were concerned, this favourable balance was somewhat offset either by having to operate in poor 'submarine country' such as the North Sea and the Baltic, or initially being obliged to use unsuitable submarines such as the 'O' class boats in Mediterranean waters. To illustrate the former point, the first three British submarine losses attributable to enemy action all occurred in the shallow Heligoland Bight within the space of only three days. The German ships involved were non-specialist auxiliaries, and their lack of sophisticated gear was compensated by the initial failure of the British to appreciate the dangers of operating in such areas. German surface ships were to enjoy little further success in North European waters and it was in the Mediterranean that the British suffered by far the greater number of their losses. The much maligned Italian navy had developed excellent ASW ships in their 'torpedo boats' which, like similarly-categorized German vessels, were really light destroyers. Both they and defensive minefields were used imaginatively, accounting between them for possibly 39 British boats. Interestingly, only four boats were officially listed as lost to enemy submarine action, suggesting far better discipline in surface navigation than that common in the enemy's boats. The end of the Mediterranean war virtually marked the end of British submarine losses to direct enemy action. Of those boats transferred to the Far East only two or three were destroyed directly by Japanese forces. The Germans, particularly, lacked the AS organization that was so necessary to the Allied cause: the technology, the co-operation between aircraft, carriers and escorts and, above all, the intelligence that was kept a secret so well. Paradoxically, the Germans also lacked the great convoys that proved such magnets to submarines, catalysts to activate the killing grounds where the escorts operated.

Though they could never afford to take chances with Japanese AS forces, the Americans learned early that they had nothing unusual in their armoury. With US submarines operating on the surface at night, they were open (as were those of the Germans) to radar-aided counterattack, but the Japanese kept their escorts a low priority for the equipment and airborne sets were not common before 1944. Having early developed a radar emission detector, the Japanese were often loth to use their own radar in case their enemy might, in turn, detect them through it.

The Japanese experimented with exotica such as circling AS torpedoes and an early airborne MAD (Magnetic Anomaly Detector) but scored best with the intelligent use of standard weapons such as deep-laid mines at strategic points and plenty of depth charges. The latter, however, were reduced in effectiveness by the building of too few escorts of too high quality.

Possibly most significant of all was the consistent over-optimism concerning sinkings of submarines by the Japanese. The Americans did nothing to contradict these, with the result that the Japanese always underestimated the weapon that was throttling them and did little to improve their measures to counter it.

Aus Liebe
GRUSS
AN
CHURCHILL

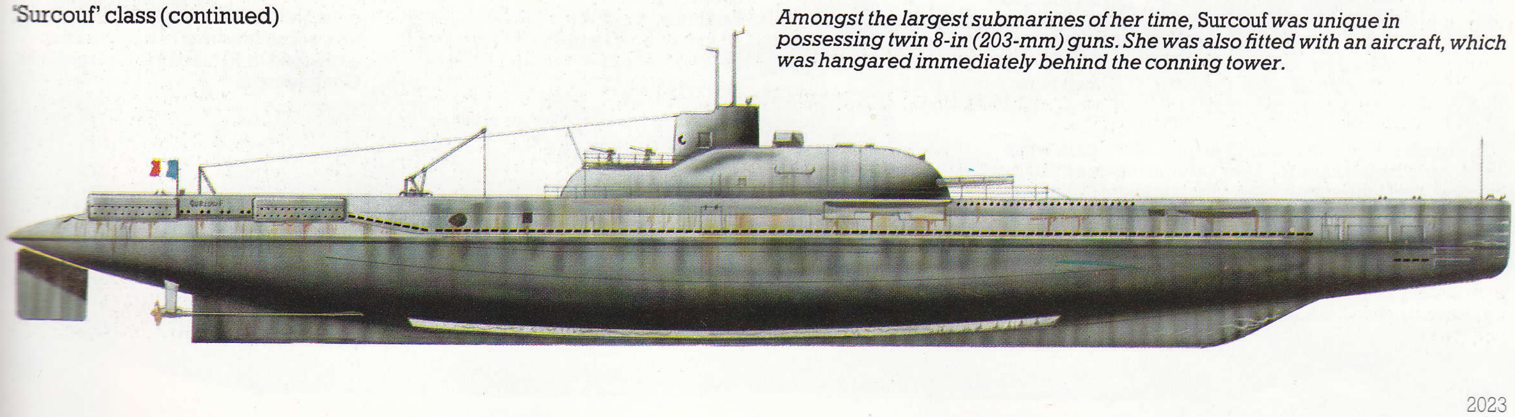


Left: A German sailor inscribes his mine with a suitably facetious dedication. German minelaying was to cause British submarines much inconvenience in northern waters, but German surface vessels proved unable to defeat the underwater threat.

Above: Depth charges ready for action aboard a German escort. As the German army was steadily pushed back by the Russians, so control of the Baltic coast assumed greater importance and the Germans were faced with an increasingly effective Soviet submarine fleet.

'Surcouf' class (continued)

Amongst the largest submarines of her time, Surcouf *was unique in possessing twin 8-in (203-mm) guns. She was also fitted with an aircraft, which was hangared immediately behind the conning tower.*



USA

Old 'S' class

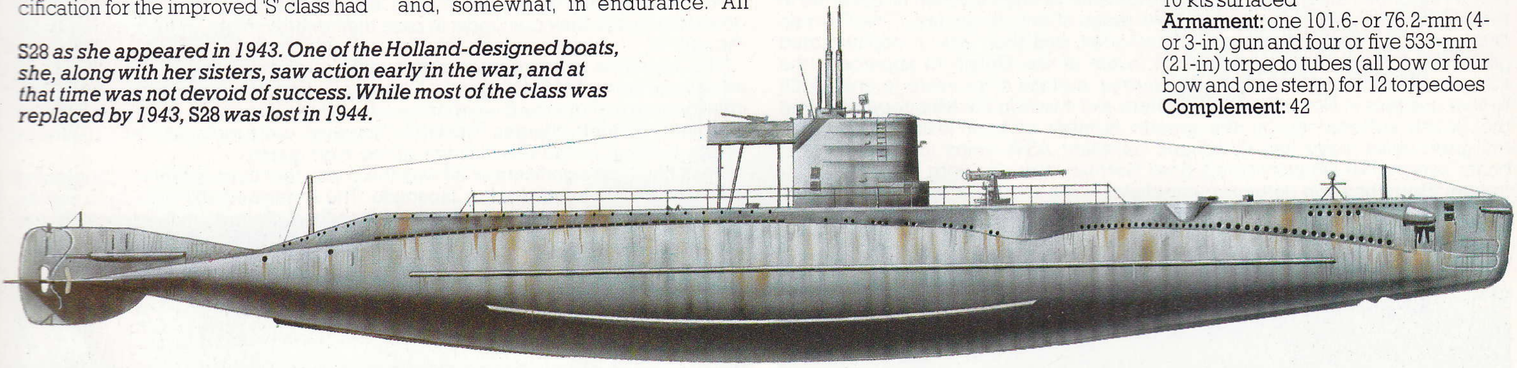
Like the 'O' and 'R' classes, the World War I-designed **'S' class** (or 'Sugar') boats were well represented in the US Navy in December 1941, when the USA found itself in World War II. Sixty-four of these boats were still available, though many had for years been involved only in training. All suffered from having been designed at a time when the submarine was still regarded by the US Navy as a weapon for use in the defence of home territory. None, therefore, had adequate endurance for the Pacific operations that, with Japan as an ally in 1914-8, had not been foreseeable.

The 'O' and 'R' boats were fitted with 457-mm (18-in) torpedo tubes and had poor endurance, and the general specification for the improved 'S' class had been put out to competition. At this time, US submarine practice was dominated by the companies owned by Holland and Lake; each tendered, together with the Portsmouth Navy Yard. Three prototypes were built to the designs, the *S2* by Lake being thought unsatisfactory. In total, 25 Holland-designed boats, known as the **'S' class Group 1**, were launched between 1918 and 1922, followed by six of an improved version known as the **'S' class Group 3**. The 15 **'S' class Group 2** boats were to the naval design (some built by Lake's yard), and these were followed by four improved **'S' class Group 4** boats. Though all had about the same speed, armament and complement, they varied greatly in size and, somewhat, in endurance. All were of double-hulled design, one carried a seaplane for an experimental period, and four were fitted with an extra tube aft.

Six were transferred to the Royal Navy early in the war, one then being passed on to the Poles. As the ***Jastrzab*** she was sunk in error by the British in the course of a convoy action in 1942; by tragic irony, one of the escorts concerned was also ex-American, the 'four-piper' HMS *St Albans*. Most of the American 'S' class boats in the Far East had been replaced by newer boats by late 1943, but some had success. Before the Savo Island action, for instance, Mikawa's approach was sighted and reported by the ***S38***, and the ***S44*** exacted a toll of the victors by sending the *Kako* to the bottom. In October 1943 this old veteran's luck ran out and she was sunk near the Kamchatka peninsula.

Specification

Old 'S' class (first group)
Displacement: 854 tons surfaced and 1,065 tons submerged
Dimensions: length 66.83 m (219.25 ft); beam 6.30 m (20.67 ft); draught 4.72 m (15.5 ft)
Propulsion: two diesels delivering 894.8 kW (1,200 bhp) and two electric motors delivering 1118.6 kW (1,500 hp) to two shafts
Speed: 14.5 kts surfaced and 11 kts submerged
Endurance: 9270 km (5,760 miles) at 10 kts surfaced
Armament: one 101.6- or 76.2-mm (4- or 3-in) gun and four or five 533-mm (21-in) torpedo tubes (all bow or four bow and one stern) for 12 torpedoes
Complement: 42



***S28* as she appeared in 1943. One of the Holland-designed boats, she, along with her sisters, saw action early in the war, and at that time was not devoid of success. While most of the class was replaced by 1943, *S28* was lost in 1944.**

USA

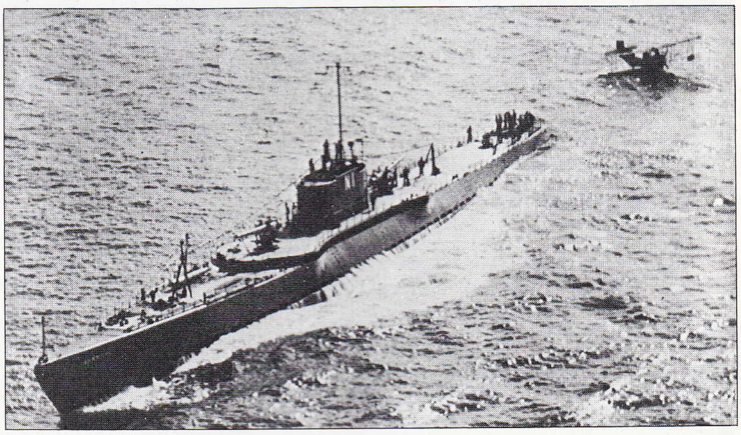
'Narwhal' class

The two **'Narwhal' class** units USS ***Narwhal*** and ***Nautilus*** must be classed as a group with the USS ***Argonaut*** that immediately preceded them. The large German transport submarines that worked the eastern US seaboard during World War I made a great impression on an oceanically-minded navy, and the early 1920s saw designs produced for a minelayer (***V-4***, later *Argonaut*) and two cruiser submarines *Narwhal* (**V-5**) and *Nautilus* (**V-6**). They were all large, even the latter boats (3.20 m/10.5 ft the shorter) being of greater length than the monstrous French *Surcouf*. As a minelayer, the *V-4* could load 60 mines, which were laid through two tubes exiting beneath the counter.

Forward of the after bulkhead of the engine room the 'Narwhals' were nearly identical, mounting two torpedo tubes aft in place of the mine stowage, a smaller demand on space that accounted for their shorter length. To match the boat's endurance, torpedo stowage was on a grand scale, upwards of 36 being carried both within the hull and the casing topside. To stretch them even further, two 152.4-mm (6-in) deck guns were mounted, the largest in any American submarine. Scouting for targets was the task for a small seaplane, the plans for which were, however, dropped.

All were considered slow by US standards but, though all were due to be re-engined, only the *Nautilus* was so modified by the outbreak of war. The latter was fitted also with two extra tubes in the after casing and the other two gained four, all in the amidships casing, two firing forward and two aft.

Despite the US fleet's shortage of submarines in 1942, these three boats were considered too slow and vulnerable for combat patrols and were modified in various degrees for clandestine operations, running personnel and supplies. The *Nautilus* had facilities for refuelling long-range seaplanes, an echo of Japanese practice, but was never so used during hostilities. All operated particularly between their west Australian bases and the Philippines. The *Nautilus* finished off the stricken Japanese carrier *Soryu* after Midway, and landed personnel on an unoccupied island near Tarawa to build a secret airstrip. Other raids were carried out on Makin Island and Attu in the Aleutians. The *Argonaut* was lost in 1943.

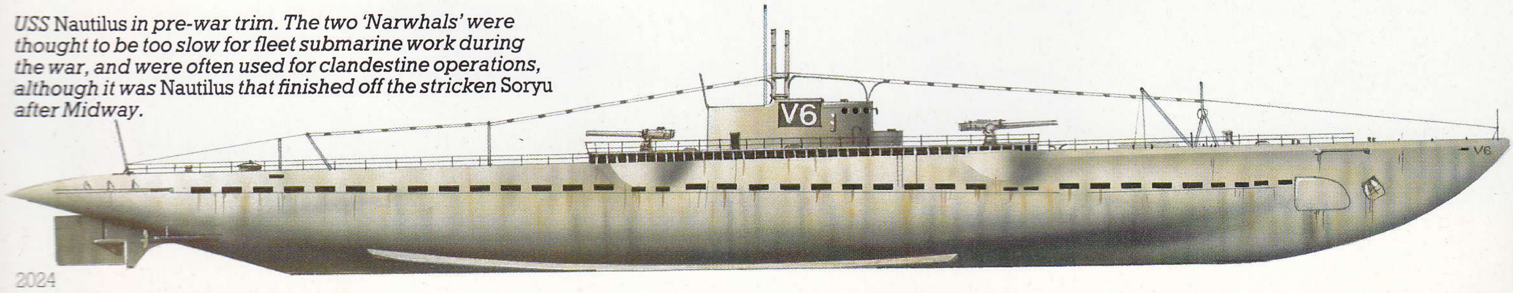


***Narwhal* and her sisters were the largest submarines in US service until the arrival of the nuclear submarines of the 1950s. In a scene from the happier pre-war days, *Narwhal* is seen towing a seaplane with engine trouble back to Pearl Harbor.**

Specification

'Narwhal' class (as built)
Displacement: 2,730 tons surfaced and 3,900 tons submerged
Dimensions: length 112.95 m (370.58 ft); beam 10.13 m (33.25 ft); draught 4.80 m (15.75 ft)
Propulsion: combination drive with four diesels delivering 4026.8 kW (5,400 bhp) and two electric motors delivering 1894.1 kW (2,540 hp) to two shafts
Speed: 17 kts surfaced and 8 kts submerged
Endurance: 33354 km (20,725 miles) at 10 kts surfaced and 93 km (58 miles) at 5 kts submerged
Armament: two single 152.4-mm (6-in) guns and six 533-mm (21-in) torpedo tubes (four bow and two stern) later increased to 10 tubes for 40 torpedoes
Complement: 89

USS* Nautilus *in pre-war trim. The two 'Narwhals' were thought to be too slow for fleet submarine work during the war, and were often used for clandestine operations, although it was* Nautilus *that finished off the stricken* Soryu *after Midway.



Strangling Japan

For all the efficiency and courage of the Japanese Imperial Navy, deficiency in pre-war planning meant that when the mighty American war machine got into its stride they had no answer to the three-pronged attack on, above and below the sea. Of all the arms of the US Navy, it was the submarine that brought Japan to its knees.

So great an impression did the nuclear bombing of Japan make in August 1945 that it is widely assumed that this weapon won the war. It did not. The rambling Japanese empire had already been defeated because it had no answers to the assaults of the fast carrier groups, to the outflanking amphibious operations and to the iron ring of the submarine blockade.

One reason for Japanese creation of the so-called 'Greater Co-Prosperity Sphere' was to gain access to raw materials, coal, iron ore, oil, tin, rubber, etc., with which the home islands were poorly provided. This wider empire was created rapidly and efficiently by the campaigns of early 1942 but, thereafter, the key to sustaining it lay in the free movement of mercantile traffic, both in the transport of commodities and the support of the many necessary garrisons.

The Japanese high command had gambled on the Western states accepting a fait accompli after Pearl Harbor. They underestimated the outrage caused in the USA, and the UK though down was far from out.

The UK had long suffered assaults on her vital and vulnerable mercantile marine and the still-recent submarine offensive by the Kaiser's fleet had only barely been weathered. The lessons were well learned and were also well appreciated by the US Navy which, yet unable to undertake the vast operations of a few years hence, resolved to strike at the busy network of Japanese commerce with the only effective weapon at its disposal, its submarine arm.

For their part, the Japanese operated a superb surface fleet but, like the UK's Grand Fleet of World War I, this was drilled to think offensively against the day of the Armageddon of a sea battle that would decide the mastery of the Pacific. Its considerable submarine arm existed to scout for the fleet and to ambush that of the enemy. Submarine assault on merchant shipping, despite its critically important implications, was not in line with offensive strategy. Conversely, it seems not to have been considered that an opponent would adopt just these tactics and Japan thus started hostilities with no plans for convoy, few escorts and little preparation for the rapid replacement of lost tonnage.

Paradoxically, the American submarine arm had been built on the twin precepts of home defence and 'go for the warships'. It took the assault on Pearl Harbor to force the decision to adopt unrestricted submarine warfare. Initially, boats worked out of both the Philippines and Pearl Harbor but, with the overrunning of the former, the 28 survivors of the Asiatic Fleet boats fell back on Australia and Hawaii.

As yet inexperienced and overwhelmed by the scale of the onslaught, they could do little but hinder the enemy's plans, but the USS *Swordfish*'s sinking of the *Atsutusan Maru* (8,660 grt) was to be the first drop in what was to become a deluge.

Fifty boats of various vintages were available for deployment. Though at first spread thinly, they soon began to concentrate at points where they could exploit the Japanese practice of sailing unescorted and singly, often still lit, a situation obtaining until about April 1942. The first enemy warship kill by SubPac boats was on 27 January 1942, when the USS *Gudgeon* sank the surfaced submarine *I-173*. On 8 February the old 'pig-boat' USS *S-37* used the German trick of exploiting her small silhouette in a surfaced night attack, sinking the destroyer *Natsushio* in the Macassar Strait. Some skippers were to develop particular affinities toward sinking Japanese destroyers, eventually causing a crisis for the enemy.

By now the Australian port of Fremantle, with a forward base up the coast at Exmouth Gulf, were being rapidly developed for submarine operations. The enemy was striking back, using shallow water and plentiful depth charges to disadvantage the unwary or over-bold. On 11 February 1942 the USS *Shark* fell first victim to Japanese ASW ships of Celebes (Sulawesi). The USS *Perch* was so shattered by depth charges on 3 March that she had to surface and scuttle.

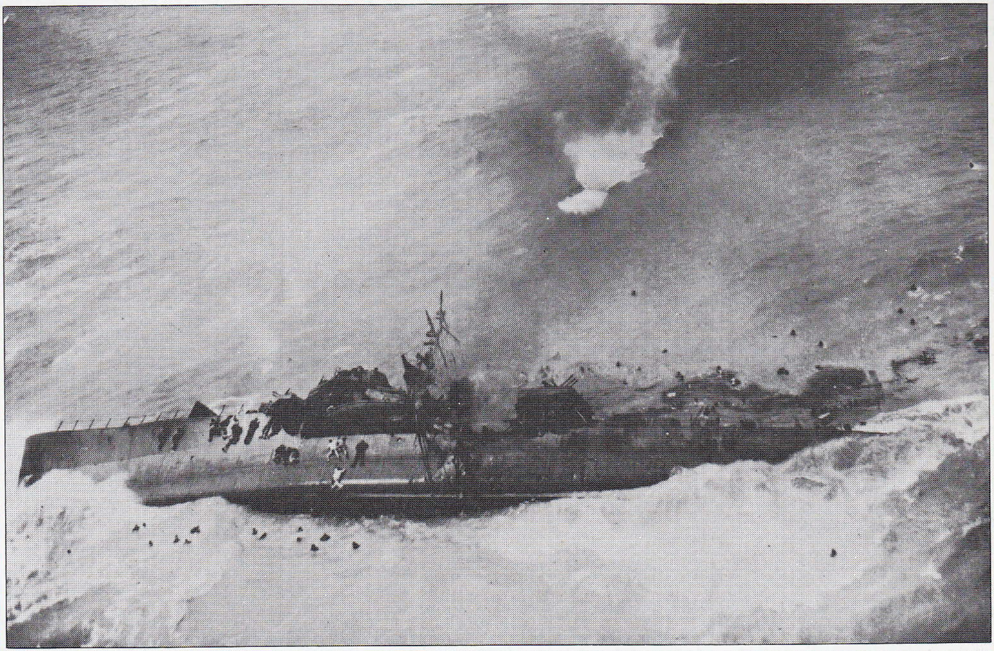
A Japanese transport lies rusting on a Pacific beach, mute testimony to the efficiency of the campaign against Japan's economic lifeline. Even coastal convoys were not safe from prowling US submarines, and the waters of the homeland itself were penetrated.

Strangling Japan

Submarine tactics were evolving in light of experience. Working ahead of a target to loose a 'down the throat' salvo of torpedoes was risky but both effective and popular. Deck guns proved invaluable, not only to avoid using precious torpedoes but because the torpedoes themselves were initially extremely unreliable. Poor depth-control and badly-designed duplex detonators frequently resulted in bitter disappointment (or worse) for crews who had risked all to stage an attack. The classic case was that of the USS *Tinosa*, which hit a large tanker with 12 out of 15 leisurely expended torpedoes. Only four exploded and the ship survived. Investigation was eventually to solve the problem and to speed the introduction of the electric torpedo.

Brisbane was then set up as a further submarine base, with boats transferred from Pearl to counter a perceived enemy invasion threat. This weathered, it was possible by mid-1942 to commence a regular close blockade of the ocean coasts of the Japanese home islands. Though convoys were now to be encountered, these were poorly escorted and the introduction of SJ surface-search radar allowed submarines to detect and track potential targets. The USS *Haddock*, the first fitted, sank two ships with its aid in August. In the first half year to June 1942, submarines accounted for 56 merchantmen of 235,000 grt. Over the following six months the toll rose to 84 ships of 358,000 grt. Things were warming up.

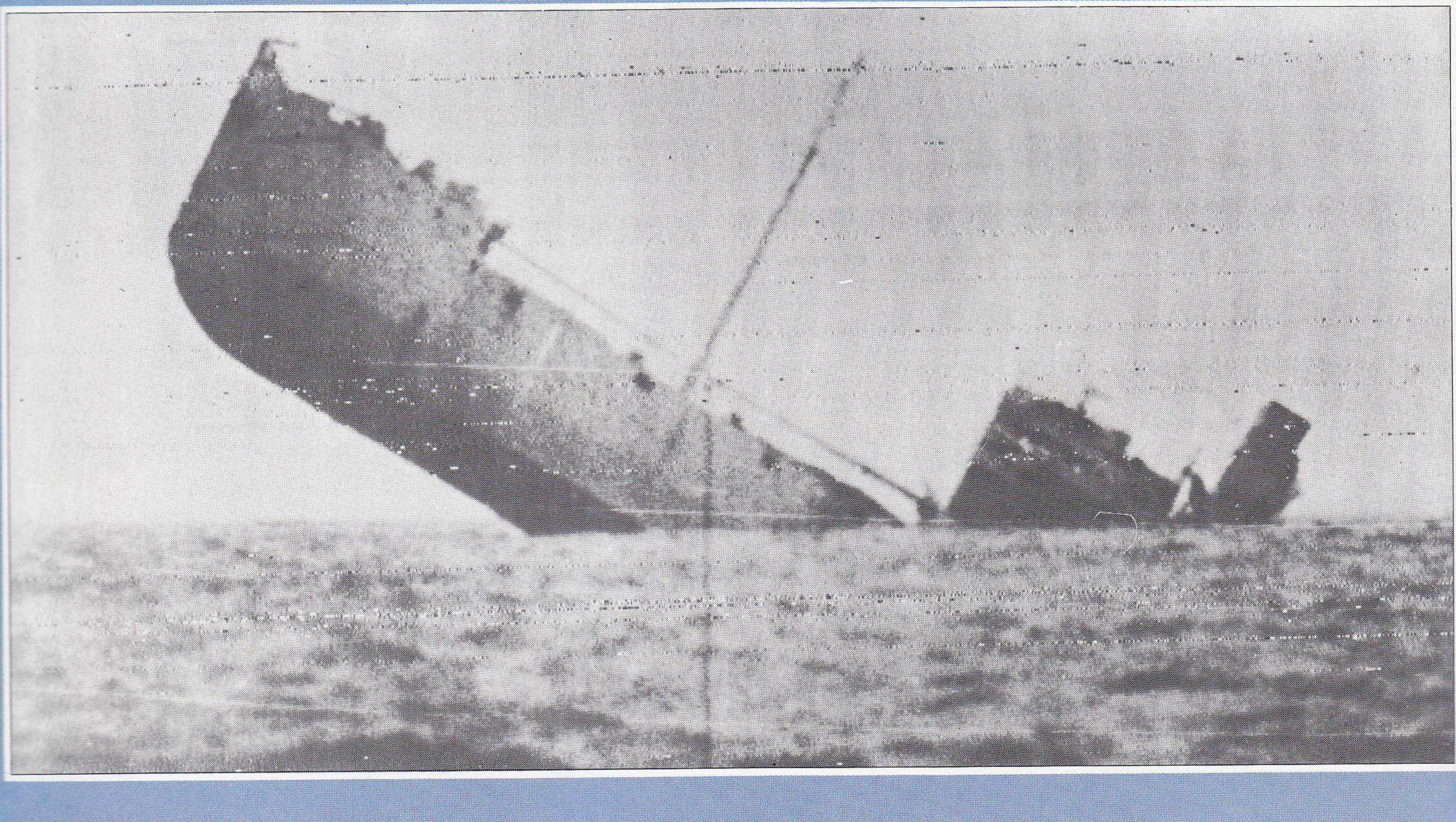
Extensive minelaying was also undertaken by submarines, causing further losses and disruption. For the steep rise in activity there was a premium to be paid. Only three boats were lost to Japanese countermeasures in 1942, but this rose to 15 during the following year. On the other hand, 1943 saw a further 308 enemy casualties, grossing some 1,367,000 tons. Even offset by replacement tonnage, this represented a 16 per cent decrease in Japan's available shipping.

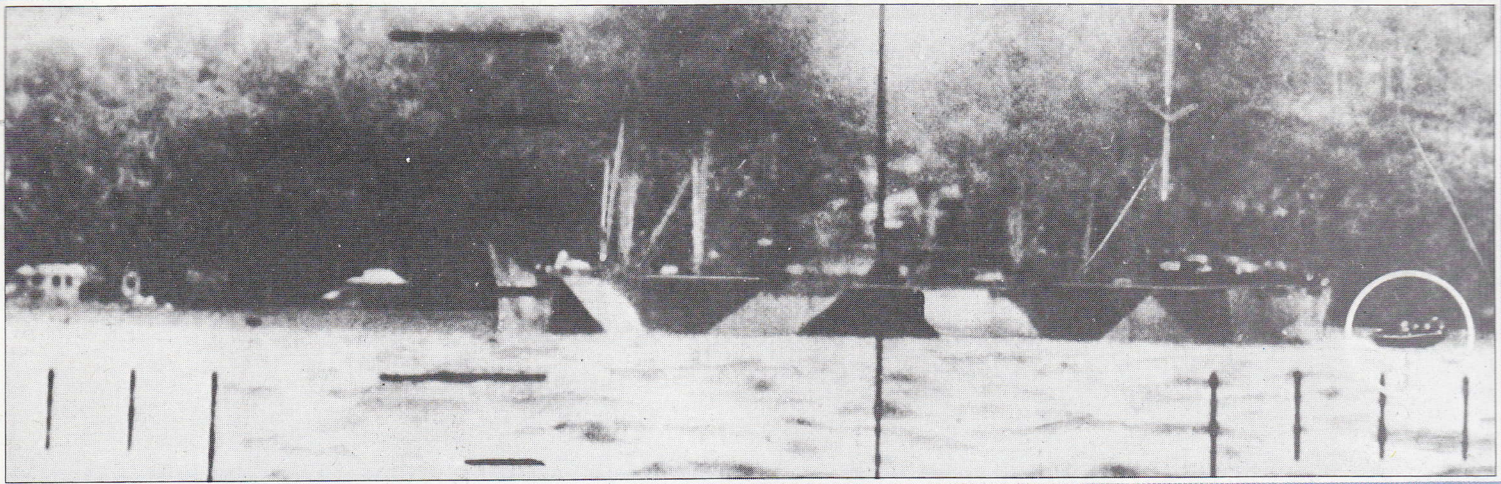


The end of a Japanese destroyer escort of the 'Ukuru' class. While merchant shipping, upon which Japanese industry was so dependent, was the most important strategic target, losses amongst the destroyers and escorts of the Imperial Navy were so serious as to make effective escorting impossible.

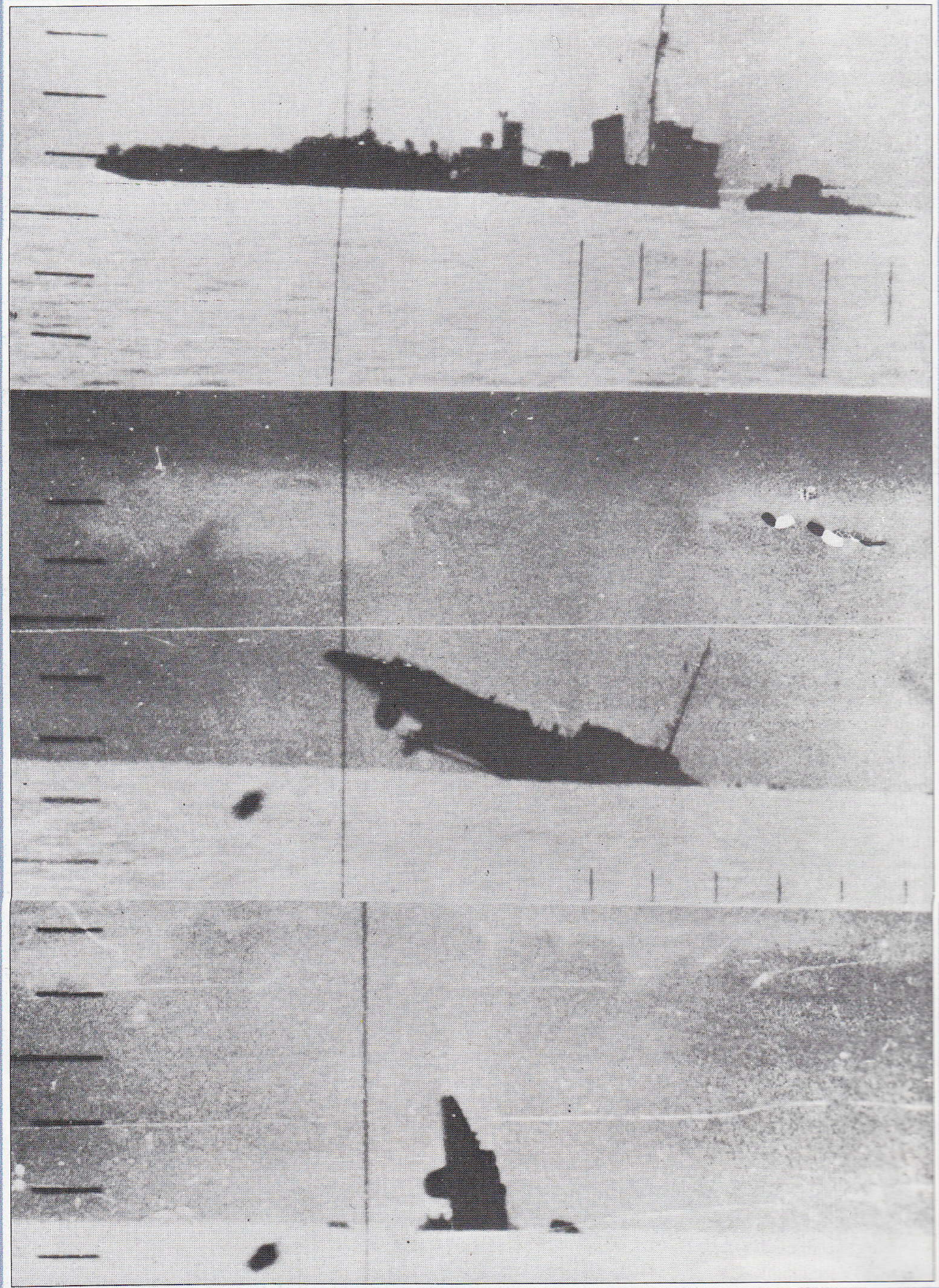
By 1944 both sides were getting more experienced. The American boats were not only more numerous but stayed longer on station by virtue of using forward staging posts, and judiciously-sited depot ships or tenders. The Japanese convoy system was getting into its stride but the submarines regrouped into 'wolf-packs' for co-ordinated attacks. Such packs, unlike the German ideals, were usually only three strong; their scale reflected the greater independent spirit of the average American commander, and their titles (Wilkin's Wildcats, Clarey's Crushers etc.,) echoed the popular freebooting approach common to all US forces. The submarine arm in the Pacific was very much the creation of Rear Admiral Charles A. Lockwood, whose drive and enthusiasm were of critical importance.

Having deluded themselves that their Pacific conquests would be accepted with equanimity, the Japanese were ill prepared to defend their sealanes against attack. Here another freighter falls victim to the US submarine fleet.





US submarines sought out Japanese shipping wherever it lay. This periscope shot shows a merchantman of 9,000 tons camouflaged in harbour with a small boat to the right. Seconds later, the submarine made a successful torpedo attack.



A periscope view of the end of an old Japanese destroyer. In the first picture, a torpedo has ripped the bows off the escort, and the other two photos show the inevitable result.

Among the star performers was 'Mush' Morton's USS *Wahoo*, which sank 20 ships of over 60,000 grt before her loss in October 1943 in La Perouse Strait. The record tonnage sunk by one submarine was a shade over 100,000 grt by the USS *Flasher* in 1944-5, and the greatest number of ships over 500 grt was 26 of 73,000 grt claimed by the USS *Tautog*. Though individual scores were way behind those of some German aces (and even some British) the sheer number of boats had the desired effect, 66 more commissioning in 1943 alone.

Massive losses

The year 1944 saw the loss of no less than 548 merchantmen of 2,452,000 grt. Though tanker construction kept pace with losses, the Japanese saw their dry cargo fleet halved. By making tankers priority targets, the Americans halved Japan's vital oil imports by the middle of 1944. Enemy shipping was now being constricted into a tighter area by American advances, and submarines competed increasingly with each other and both carrier- and land-based aircraft for the now diminishing number of targets. Early 1945 saw 160 submarines available, and the South China Sea was called Convoy College. The USS *Hoe* and USS *Flounder* even contrived to collide under water. Japanese imports from the Indies dried up.

There were still losses. A particularly bitter one was that of Dick O'Kane's USS *Tang*. Having disposed of 24 enemy ships in eight months, the boat was sunk by one of her own rogue torpedoes in the course of attacking a convoy in the Formosa Strait.

A subsidiary function of the submarines was 'lifeguarding', stationed along the routes of the Boeing B-29s that were laying waste the Japanese home islands from bases in the Marianas. Over 500 ditched aircrew were rescued in total.

The last 'Maru' of the campaign was sunk by the USS *Torsk* the day before the surrender. She was the last of 1,113, totalling 4.8 million grt. The cost had been 52 submarines.

USA

New 'S' class

The launch of USS* Swordfish*, on 1 April 1941. Few of those present could have foreseen that in nine months, within a week of Pearl Harbor,* Swordfish *would sink the first of 1,113 Japanese merchant ships to fall victim to the US submarine fleet.

Known as the **New 'S' class** because the early units confusingly took pendants of the Old 'S' class boats still in service, 16 boats were built in two very similar groups. Their design was based closely upon that of the preceding 1,320-ton 'P' class, but differed particularly in having a deeper stern to accommodate an increase in the after torpedo tube complement from two to four. The 'P' and 'S' class boats were the first all-welded submarines in the US Navy and, though techniques were still being developed, the workmanship was sound, as evinced by the survival of the USS ***Salmon*** (SS 182), lead boat of the **New 'S' class Group 1**, which was severely depth charged in October 1944 by four Japanese escorts after torpedoing a tanker off Kyushu. The combination of concussion and the effects of overpressures through being driven far below design depth left the hull dished between frames, but the boat made it home. Irreparable, she was eventually scrapped. The double hull of the American boats was a protective feature, provided that the ballast and fuel tanks within retained an ullage space over the liquid contents.

Composite propulsion systems were fitted in some, arrangements whereby the two forward diesels drove generators directly and the two after units were geared to the shafts, the gearing being shared also by two propulsion motors on each shaft. Though complex, the arrangement proved satisfactory.

Twelve reload torpedoes were located within the pressure hull and four more in external stowage in the casing, an arrangement vulnerable to the effects of depth charge attack. Two mines could be carried for each internal torpedo and laid through the tubes. Originally a 76.2-mm (3-in) gun was fitted, but this was changed to a 101.6-mm (4-in) weapon in the majority of boats. Wartime modifications saw the bulky 'sails' cut down to a profile similar to that of later classes.

The **New 'S' class Group 2** included the USS ***Squalus*** (SS 192), which foundered through an induction valve failure while on trials in May 1939. Salvaged and refitted, she survived the war as the USS ***Sailfish***. The USS ***Swordfish*** (SS 193) was credited with the first Japanese merchantman sunk, a week after the outbreak of war.

Specification

New 'S' class ('Salmon' group)
Displacement: 1,440 tons surfaced and 2,200 tons submerged
Dimensions: length 93.88 m (308.0 ft); beam 7.98 m (26.17 ft); draught 4.34 m (14.25 ft)
Propulsion: composite drive with four diesels delivering 4101.4 kW (5,500 bhp) and four electric motors delivering 1983.6 kW (2,660 hp) to two shafts
Speed: 21 kts surfaced and 9 kts submerged
Endurance: 18532 km (11,515 miles) at 10 kts surfaced and 158 km (98 miles) at 5 kts submerged
Armament: one 76.2-mm (3-in) gun (later upgraded to one 101.6-mm/4-in gun in most units) and eight 533-mm (21-in) torpedo tubes (four bow and four stern) for 24 (later 20) torpedoes
Complement: 75

USA

'Gato' class

From the New 'S' class design the Americans developed the **'T' class** submarine, a dozen of which were launched in barely 13 months, mostly in 1940. They differed primarily in receiving two extra tubes forward (10 in all) and later substituting a specially-modified 127-mm (5-in) deck gun for the earlier 101.6-mm (4-in) gun, or 76.2-mm (3-in) gun in some cases. This gradual evolutionary process was successful and produced at the right time a submarine with acceptable characteristics for the Pacific war. What was needed was a long endurance and self-sufficiency. Because of the distances involved, patrols were much longer than those in the European theatre and more boats were needed to maintain numbers on station.

Thus the **'Gato' class** was an improved 'T' and went into volume production, the first of class, the USS *Drum* (SS 228), being completed shortly before hostilities commenced. Officially capable of operating down to 91 m (300 ft) they often went deeper. The earlier boats had a large, solid looking sail, similar to those of pre-war designs. These were soon reduced as boats came in for repair but, although the structure could be lowered the very high standards ('shears') demanded by the long periscopes remained a lofty feature. Operating on the surface more than would have been possible in European waters, they began also to accumulate varied outfits of automatic weapons, regular and non-regular, the structures gaining various platforms to support them. Even extra main-calibre deck guns appeared, all in the cause of making the 24 torpedoes aboard last longer.

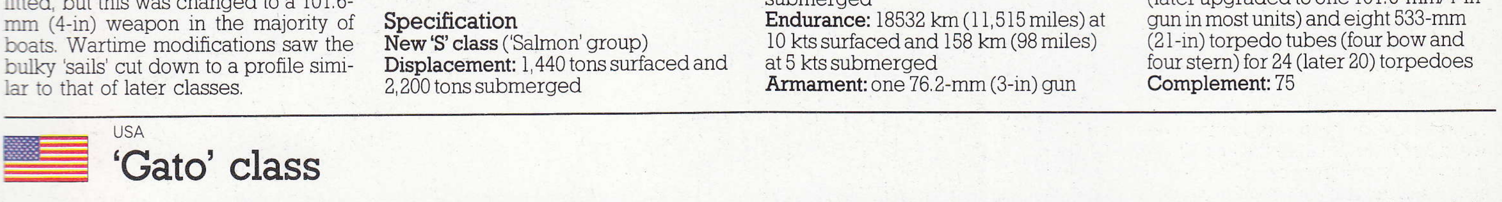
After 73 boats the hull was secretly improved by the adoption of HT steels and advanced sections, increasing their official limit to 122-m (400-ft) depths. No less than 256 of these were ordered and known as the **'Balao' class**, but only 122 were actually completed, a further 10 unfinished hulls being scrapped.

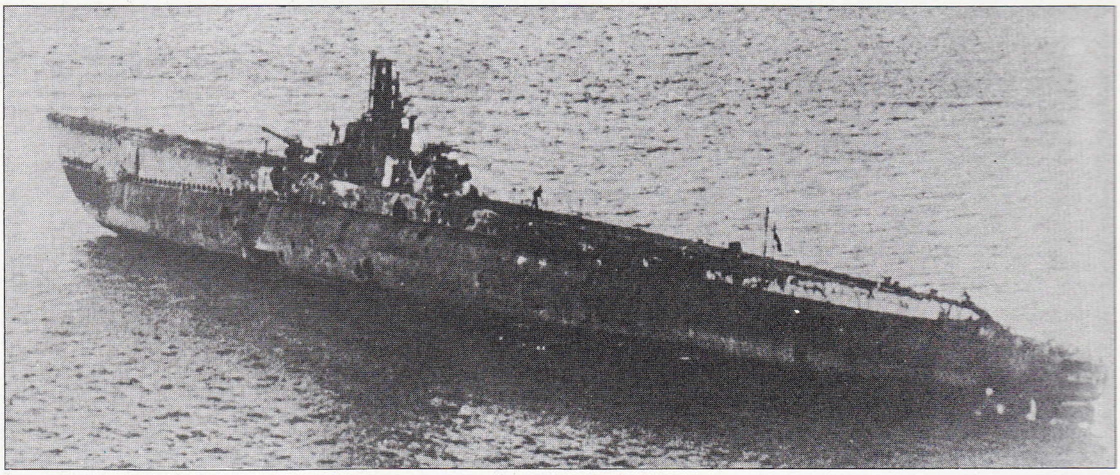
The combined group formed the backbone of the US Navy's wartime submarine strength, achieved much and suffered 29 losses. Post-war, with the example of German developments, many were modernized under the GUPPY programmes, remaining the greater part of the fleet's underwater arm until introduction of the nuclear boats. Many 'went foreign', some still serving.

Specification

'Gato' class
Displacement: 1,525 tons surfaced and 2,415 tons submerged
Dimensions: length 95.02 m (311.75 ft); beam 8.31 m (27.25 ft); draught 4.65 m (15.25 ft)

A 'Gato' class boat of late 1942. By this time production was approaching three per month from three separate yards, and operational experience was being incorporated through the adoption of a smaller sail and more weapons for surface work.





USS Darter *aground on Bombay shoal during the battle of Leyte Gulf. After the triumph of the previous day when she torpedoed and sank the cruiser* Atago *(flagship of Admiral Kurita), as well as damaging the cruiser* Takao, *she was badly damaged and finally scuttled on 24 October.*

Propulsion: four diesels delivering 4026.8 kW (5,400 bhp) and four electric motors delivering 2043.2 kW (2,740 hp) to two shafts
Speed: 20 kts surfaced and 8.5 kts submerged
Endurance: 21316 km (13,245 miles) at 10 kts surfaced and 175 km (109 miles) at 5 kts submerged
Armament: one 127-mm (5-in) gun and 10 533-mm (21-in) torpedo tubes (six bow and four stern) for 24 torpedoes
Complement: 80

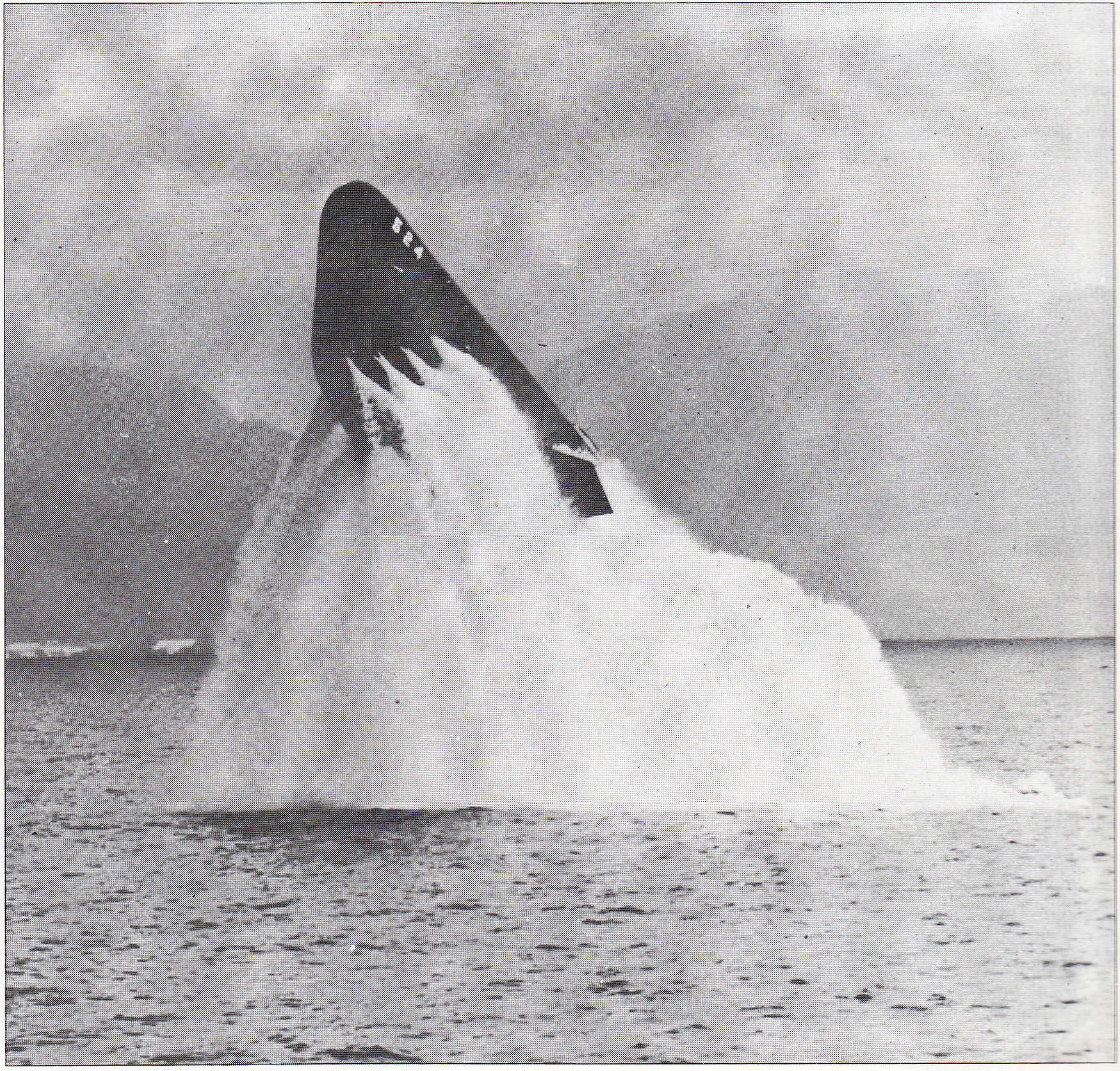
USA

'Tench' class

The **'Tench' class** marked the ultimate refinement in the basic design whose ancestry could be traced back to the 'P' class. Externally they were virtually identical with the 'Balaos', and so closely related was the design that some of the later Balao contracts were converted to 'Tenches'. Though 25 boats had been completed by the end of hostilities, most were still working up in home waters; not a dozen, therefore, managed to see operational duty and none of these was lost. Total production was 33 boats between 1944 and 1946, with another 101 cancelled or scrapped incomplete.

Differences, though not obvious, were important. The first concerned machinery. In the 'Balao' class the four diesels each ran a direct-coupled generator, which served both to charge batteries and power the electric propulsion motors when surfaced. Each shaft had two motors, coupled to it via reduction gearing. Both the high-speed motors and the reduction gear were noisy (to the extent where it was fortunate that Japanese ASW techniques and equipment were so backward). Reduction gears were also expensive, temperamental, easy to damage and, traditionally, a slow delivery item in the USA (as was the turbo-electric propulsion in battleships). It made sense, therefore, to develop a large and slow-turning motor that could be direct-coupled. Two of these larger units, with no associated gear housings, could be accommodated without the earlier awkward crank in the hull, but illustrates some of the problems facing submarine designers.

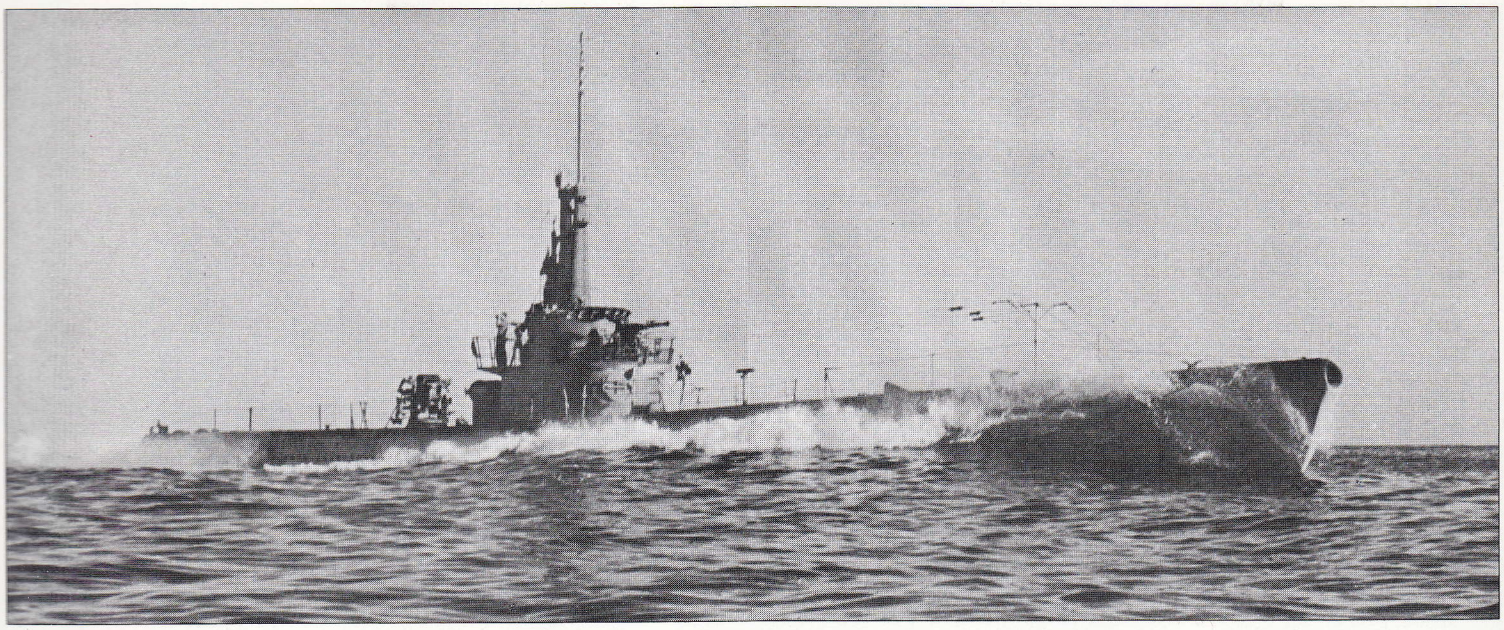
Fuel and ballast tanks were better organized, firstly to obviate the need to lead the vents of the ballast tanks through the pressure hull (where they constituted a flooding hazard) and, secondly, the better to compensate for the considerable change in weight and trim as stores were consumed during a long patrol. Even a further four torpedo reloads were squeezed in, and this, combined with radar and efficient mechanical fire-control computers, put the 'Tenches' far ahead of the opposition. In order to improve on the average, but slow, diving times of 55-60 seconds, the casings were pierced with many more lightening holes.



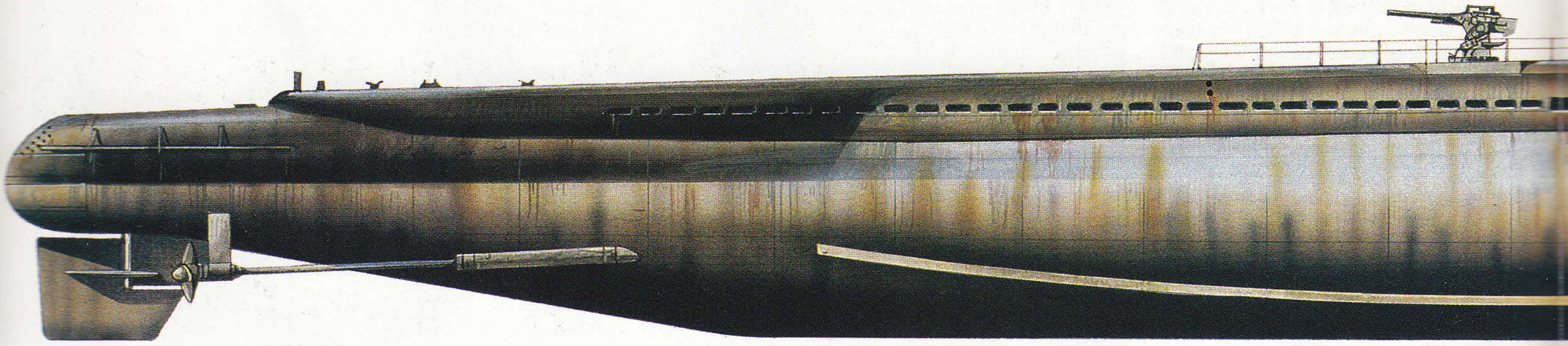
Specification

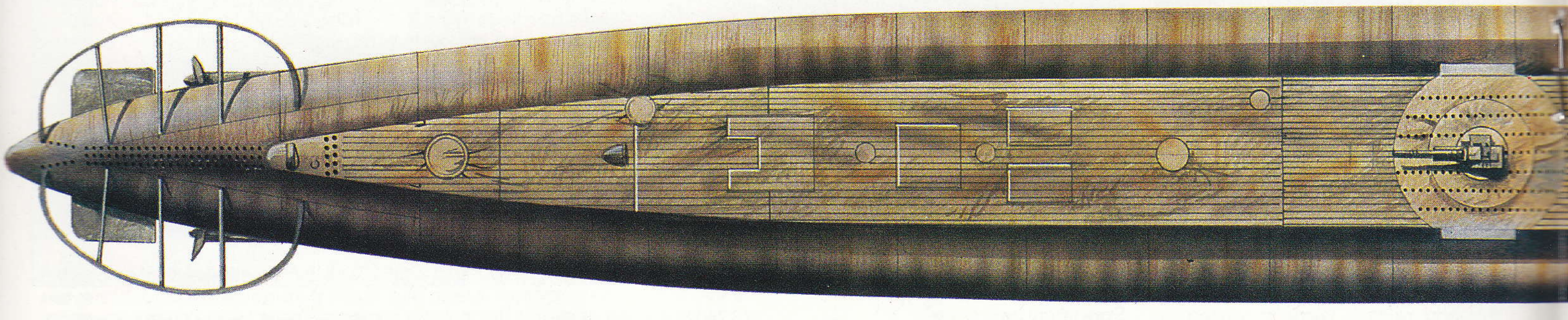
'Tench' class
Displacement: 1,570 tons surfaced and 2,415 tons submerged
Dimensions: length 95.0 m (311.67 ft); beam 8.31 m (27.25 ft); draught 4.65 m (15.25 ft)
Propulsion: four diesels delivering 4026.8 kW (5,400 bhp) and two electric motors delivering 2043.2 kW (2,740 hp) to two shafts
Speed: 20 kts surfaced and 9 kts submerged
Endurance: 21316 km (13,245 miles) at 10 kts surfaced and 204 km (127 miles) at 4 kts
Armament: one or two 127-mm (5-in) guns and 10 533-mm (21-in) torpedo tubes (six bow and four stern) for 28 torpedoes
Complement: 81

USS Pickerel, *one of the later war-built fleet submarines, caught during one of the most dramatic methods of surfacing. Transferred to Italy in 1972 after extensive updating, she served under the name* Gianfranco Gazzana Priaroggia *until 1981.*



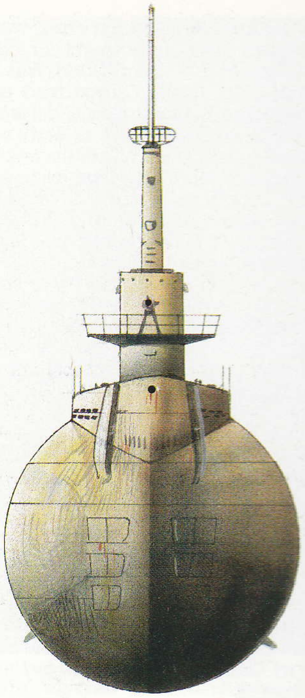
A 'Tench' class submarine in its natural environment – on the surface! By the time that this photo was taken, in June/July 1945, there were very few targets for the highly successful sub skippers, Japanese vessels having been all but swept from the seas.

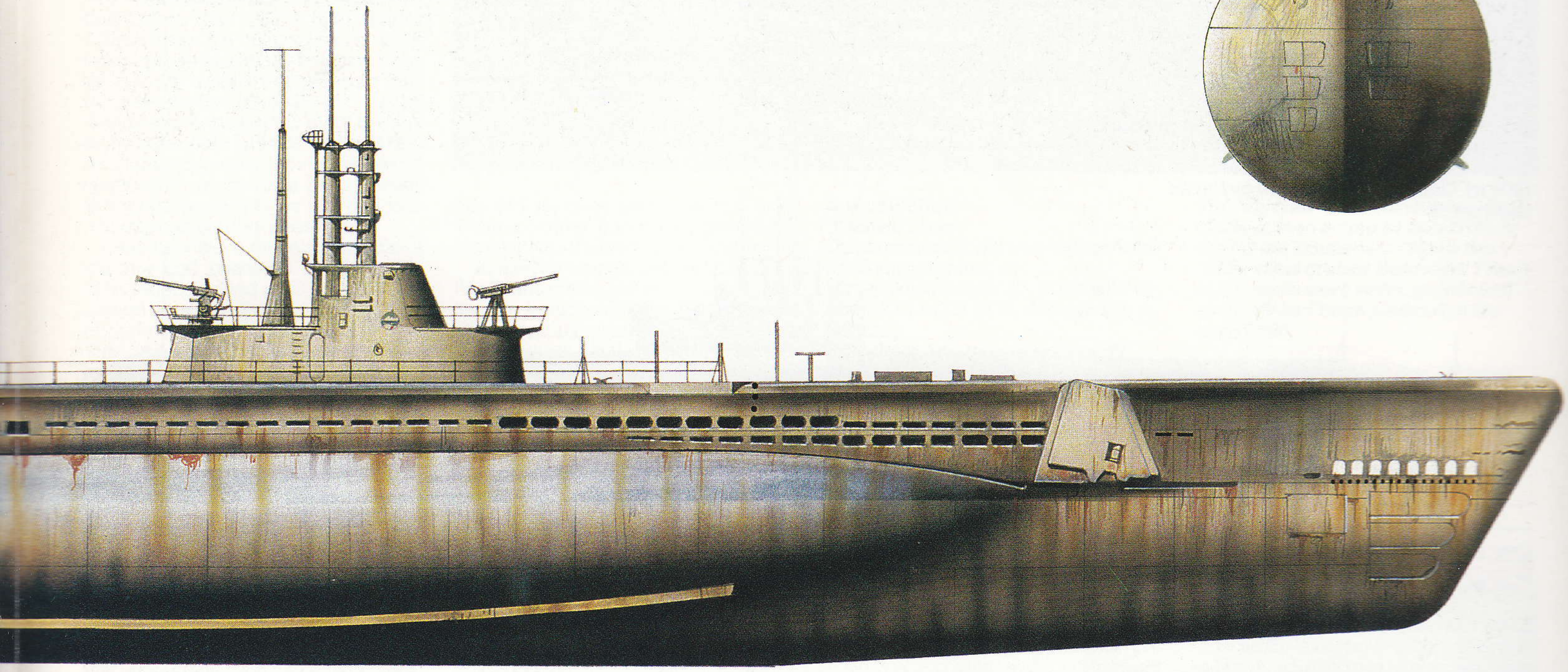


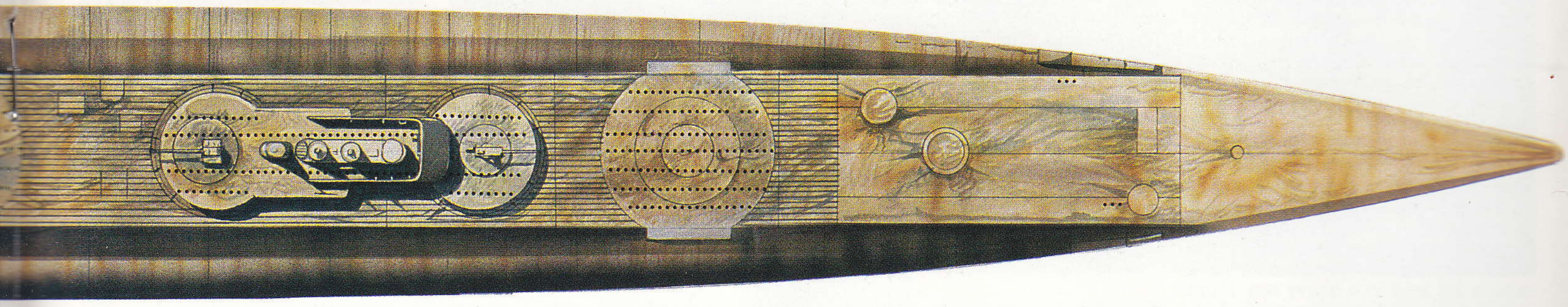


'Tench' class submarine

The fleet submarines of World War II were the US Navy's 'Gato', 'Balao' and 'Tench' designs. With a range in excess of 11,000 nautical miles (12,666 miles/20383 km), the 'Tench' class boats could operate in the home waters of the Japanese empire, and the punch packed by the 24 torpedoes carried was considerable. Although American operations were often carried out on the surface, later boats were cleared to operate at depths of 140 m (450 ft), and this hull strength stood them in good stead while under attack.







UK

'O', 'P' and 'R' classes

The **'O' class** (later **'Oberon' class**) was developed as a replacement for the ocean-going 'L' class of World War I design. They were categorized as overseas patrol submarines, and it is of interest to note that, even as early as the concept stage in 1922, there was a requirement for long range with an eye to possible future operations against Japan (an ally during 1914-8). The lead boat, HMS ***Oberon***, was laid down by Chatham Dockyard in 1924 and was closely followed by two sisters, HMS ***Otway*** and ***Oxley***. Six bow and two stern tubes were fitted, with a reload for each. These, together with extensive bunker spaces, made for a large hull which proved distinctly unhandy, with speed reduced by a plethora of external fittings. Even after much fairing and attention they barely achieved their designed surface speed, and failed altogether to reach the required speed submerged.

The hull was fitted with saddle tanks, which contained most of the ballast capacity. Some could double as extra fuel tanks but were unpopular as they inevitably emitted telltale oil traces through leaky rivet heads. As with the 'L' class boats, a 101.6-mm (4-in) gun was fitted in the tower to allow it to be worked in heavy seas.

Because of the limitations with the 'Oberons', an improved **'Odin' class** was evolved: longer to accommodate more powerful machinery and beamier to improve stability in the surfaced condition. Completed in 1928-9, these boats were HMS ***Odin***, ***Olympus***, ***Orpheus***, ***Osiris***, ***Oswald*** and ***Otus***. Though still plagued by weeping oil, their outsides were marked by a great clean-up of general clutter. An interesting idea, fortunately not pursued, was to install auxiliary accommodation in the upper casing to ease the confines of the crew on extended patrols. The **'Parthian'** and **'Rainbow' classes** were essentially 'Odin' repeats; six of each were ordered, differing only in detail. Two 'Rainbows' were ultimately cancelled, and the units completed in 1929-30 were HMS ***Parthian***, ***Perseus***, ***Phoenix***, ***Poseidon***, ***Proteus***, ***Pandora***, ***Rainbow***, ***Regent***, ***Regulus*** and ***Rover***.

Most of the 'O' class boats were in the Far East in September 1939 but one of those in home waters, the *Oxley*, had the melancholy record of being the first British submarine lost when torpedoed in error by another British submarine, HMS *Triton*. Of the joint class total of 18, 12 were lost, most by the end of 1940 and many in the Mediterranean, for whose confines they were totally unsuited.

Specification

'Odin' class

Displacement: 1,781 tons surfaced and 2,038 tons submerged

Dimensions: length 86.41 m (283.5 ft); beam 9.12 m (29.92 ft); draught 4.17 m (13.67 ft)

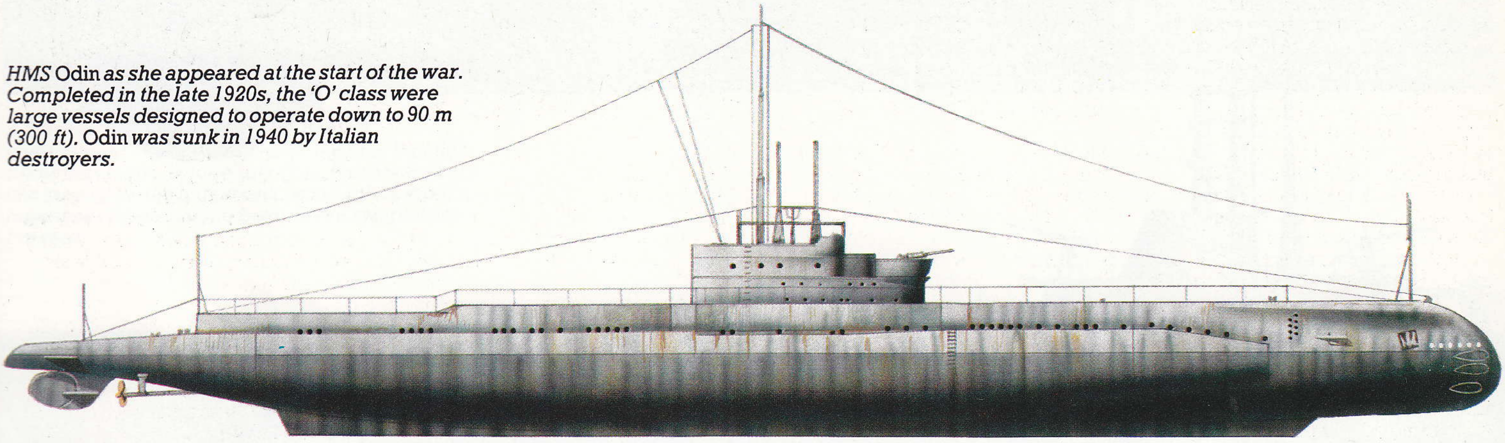
Propulsion: two diesels delivering 3281.1 kW (4,400 bhp) and two electric motors delivering 984.3 kW (1,320 hp) to two shafts

Speed: 17.5 kts surfaced and 9 kts submerged

Endurance: 21123 km (13,125 miles) at 8 kts surfaced and 97 km (60 miles) at 4 kts submerged

Armament: one 101.6-mm (4-in) gun and eight 533-mm (21-in) torpedo tubes (six bow and two stern)

Complement: 53



HMS **Odin** ***as she appeared at the start of the war. Completed in the late 1920s, the 'O' class were large vessels designed to operate down to 90 m (300 ft).*** **Odin** ***was sunk in 1940 by Italian destroyers.***

UK

'Porpoise' class

Based on the recently-completed 'Parthians', the **'Porpoise' class** submarines were purpose-built minelayers. German practice tended to near-vertical mine shutes located within the envelope of the pressure hull, but the British preferred external stowage, despite risk of damage from overpressures or depth-charging. 'E' and 'L' class minelayers had had stowages in the saddle tanks on each side but, in the experimental conversion of the *M3* in 1927, tracks were laid atop the hull over the greater part of her length and inside the free-flooding space contained within an extra-deep casing. An endless-chain mechanism fed the mines through doors right aft as the submarine moved slowly ahead. This system was basically that incorporated in the 'Porpoises'; in the name ship it extended over about three-quarters of her length, but was longer in the remainder. All this gear added about 54 tons of topweight, making the boats very tender when first surfaced with a full load in a heavy sea. Extra lightening holes improved both draining and flooding time, allowing the boats also to dive more quickly. Launched between 1932 and 1938, the boats were HMS ***Porpoise***, ***Grampus***, ***Narwhale***, ***Rorqual***, ***Cachalot*** and ***Seal***. Three other units were cancelled.

Being weight-critical the class took rather small diesel engines, resulting in a modest surface speed. To avoid detection from fuel leaks all bunkers were internal, it being found necessary to extend the pressure hull downwards like a box keelson to meet the saddle tanks. This oddly-shaped and weaker cross-section undoubtedly contributed to the designed depth being limited to 91 m (300 ft) compared with the 152 m (500 ft) of the 'Parthians'.

The main function of the 'Porpoises' was, officially at least, superseded by the development of a mine capable of being laid through a conventional torpedo tube. But despite this the class was still to lay some 2,600 mines operationally. They proved invaluable during the height of the siege of Malta when, in concert with the available 'O' class boats, they moved in personnel and supplies. The *Seal*, after damaging herself by mine in the Kattegat and unable to dive, had to surrender to two Arado floatplanes. Repaired, she was recommissioned as the ***UB-A*** but not used operationally. Only the *Rorqual* survived World War II.

Specification

'Porpoise' class

Displacement: 1,768 tons surfaced and 2,053 tons submerged

Dimensions: length 88.09 m (289.0 ft); beam 9.09 m (29.83 ft); draught 4.88 m (16.0 ft)

Propulsion: two diesels delivering 2460.8 kW (3,300 bhp) and two electric motors delivering 1215.5 kW (1,630 hp) to two shafts

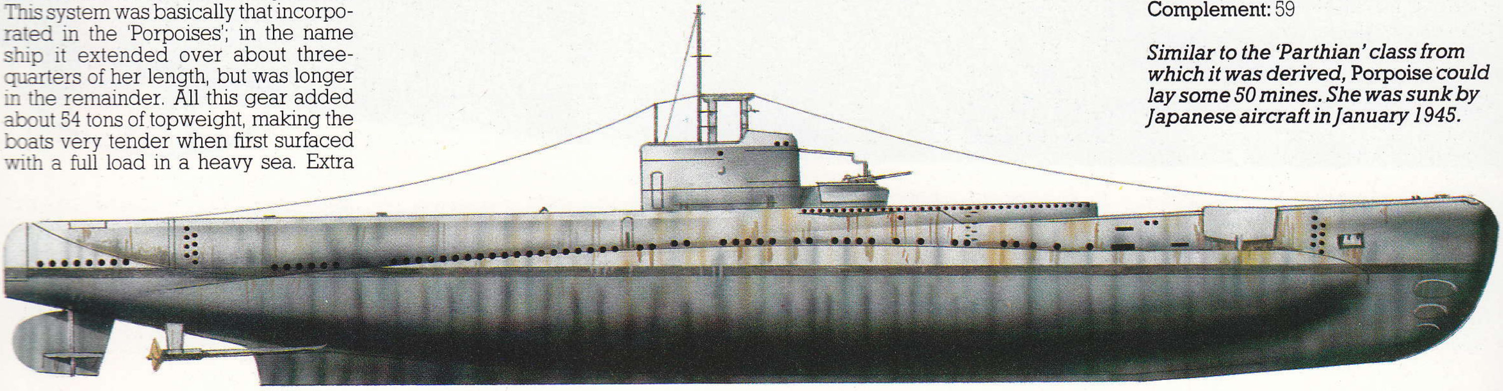
Speed: 15.5 kts surfaced and 9 kts submerged

Endurance: 21308 km (13,240 miles) at 8 kts surfaced and 122 km (76 miles) at 4 kts submerged

Armament: one 101.6 mm (4-in) gun, six 533-mm (21-in) torpedo tubes (all bow) for 12 torpedoes, and 50 mines

Complement: 59

Similar to the 'Parthian' class from which it was derived, **Porpoise** ***could lay some 50 mines. She was sunk by Japanese aircraft in January 1945.***



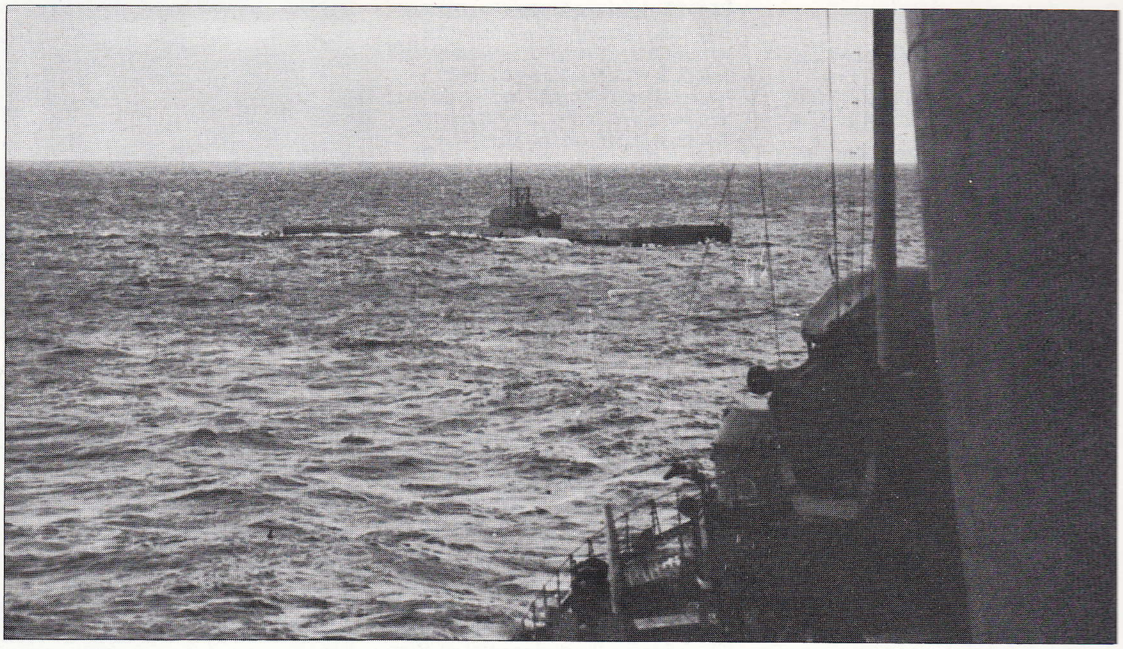
UK

'Thames' class

With the steam-driven 'K' class boats and the experimental *X1*, the Royal Navy had attempted to produce submarines with characteristics appropriate for operations with the surface fleet. Unfortunately, the 'K' boats were disastrously problem-prone and the *X1* remained a one-off. The requirement still existed, therefore, for a boat to fill the role while avoiding the weaknesses of the 'O' class. Adhering to the limitations of the Geneva Conference it was decided to build 20 boats, each of the maximum allowable surface displacement of 1,800 tons, with the combined functions of fleet work and long-range patrols. In the event, with the surface fleet becoming faster, policy was changed and only three of the class were completed between 1932 and 1934 as the **'Thames' class** units HMS ***Thames***, ***Severn*** and ***Clyde***. The boats were only 1.83 m (6 ft) shorter overall than the monstrous 'K' class boats and were actually beamier overall, despite a narrower pressure hull. In cross-section the hull was carried downward at the keel to meet the line of the outer hull. Little oil fuel was carried inboard, most of it being stowed in spaces above the main ballast tanks. Weepage was apt to be into the main hull through started rivet-heads.

Only now were diesels available of the size and power to match the 'K' class legend speed of 23.5 kts. Engine design was by the Admiralty, and turned out to be lighter than forecast. This was fortunate as the boats were highly weight-critical. For their extended patrols, for instance, 41 tons of fresh and distilled water were carried, some two per cent of surface displacement. General submarine policy of substituting 101.6-mm (4-in) for 119.4-mm (4.7-in) guns saved some 6 tons, while a further 8 tons was gained by burning fuel of a lower specific gravity.

In the Norwegian campaign of 1940, the *Thames* was lost on a mine, while the *Clyde* succeeded in damaging the *Gneisenau* by torpedo. The *Clyde* ran an invaluable 1,200 tons of supplies to a beleaguered Malta and sank several enemy merchantmen while working out of Gibraltar. The *Severn* was active for a time in the little-known Levant operations.



The 'Thames' class submarine HMS Clyde *is seen acting as escort while the tanker* Dingledale *refuels the 'Dido' class cruiser* Hermione. *These large boats were very capable and about 20 had been planned in the early 1930s.*

Specification
'Thames' class
Displacement: 2,165 tons surfaced and 2,680 tons submerged
Dimensions: length 105.16 m (345.0 ft); beam 8.61 m (28.25 ft); draught 4.78 m (15.67 ft)
Propulsion: two diesels delivering 7457.0 kW (10,000 bhp) and two electric motors delivering 1864.25 kW (2,500 hp) to two shafts
Speed: 22.5 kts surfaced and 10.5 kts submerged
Endurance: 18532 km (11,515 miles) at 8 kts surfaced and 219 km (136 miles) at 4 kts submerged
Armament: one 101.6-mm (4-in) gun and six 533-mm (21-in) torpedo tubes (all bow) for 12 torpedoes
Complement: 61

UK

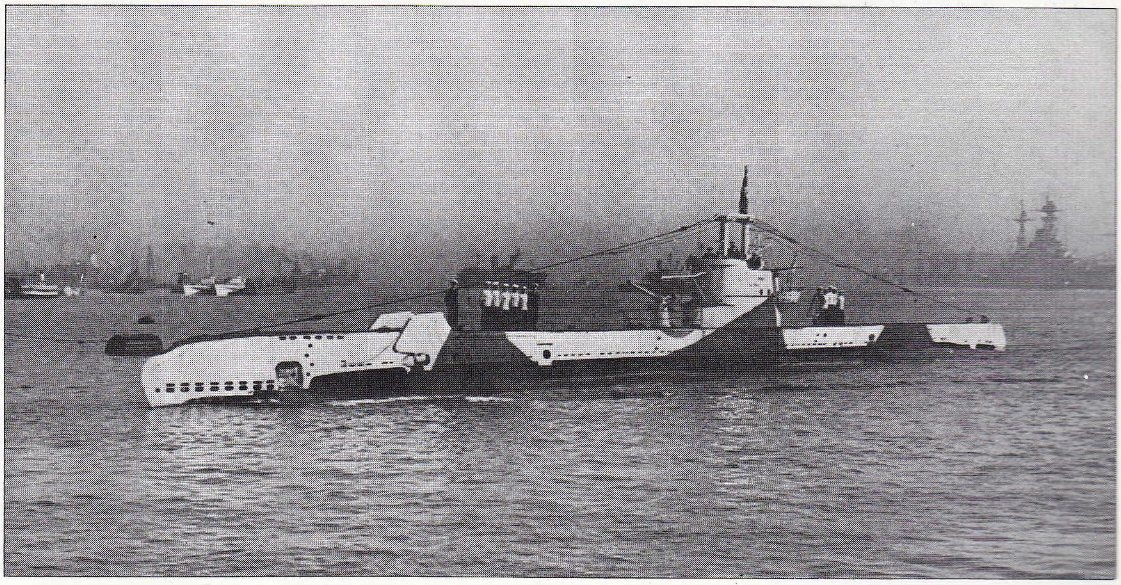
'S' class

Though its origins went back to 1928, the **'S' class** was highly successful during the war and, with 62 completions, was the Royal Navy's most prolific class. Ostensibly 'H' class replacements, the performance of the 'S' class boats was required to be enhanced to allow operation in the Baltic and Mediterranean. A tight, 600-ton surfaced displacement target was set to produce a small submarine which, nevertheless, was required to be able to transit 805 km (500 miles) to and from its patrol area, where it was expected to remain up to 10 days. Any increase in the 805-km (500-mile) range meant having to find space for very much larger radio equipment. The specification was later to be altered drastically, calling for 1930-km (1,200-mile) passages at not less than 9 kts and eight days on station.

Initially, a class of four (**'Swordfish' type**) was built; launched between 1931 and 1933 by Chatham Dockyard, these displaced 640 tons despite every effort at weight control. The design was really too tight and was relaxed to 670 tons for the eight lengthened **'Shark' type** boats of 1934-7. Though it was planned to terminate the class at 12, war saw the design stretched further and constructed in series.

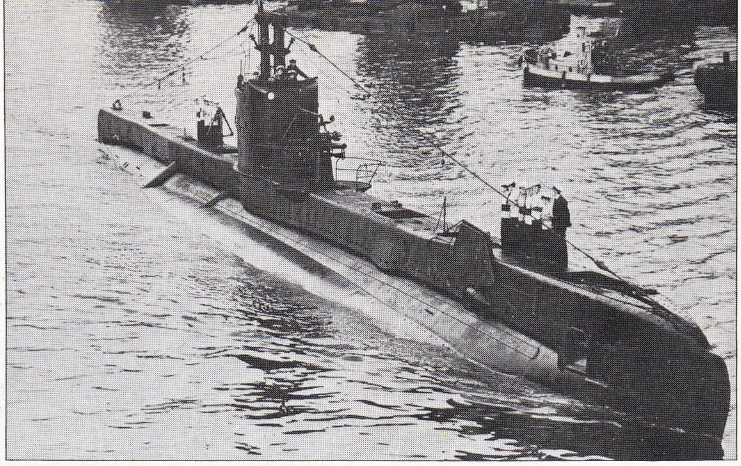
To save on topweight a 76.2-in (3-in) gun was fitted but, with the extra hull length, a further torpedo tube was worked-in aft on some boats. Others traded both of these for a single 101.6-mm (4-in) gun. With only 12 or 13 torpedoes aboard, the gun was a useful means of disposing of 'soft' targets which, while not warranting the expenditure of a torpedo, were often reluctant to sink. Earlier boats had fuel tanks within the pressure hull, but later units supplemented these with external capacity, which allowed them to work even in the Far East.

Interestingly, eight units were lost from the original 12, the same number as were lost from the following 50. All of the first group losses occurred before February 1941, while the first hull of succeeding groups was not launched until October 1941. Submarine operations in European waters during the early months of the war were clearly hazardous.



HMS Storm *returns to the UK in 1945. During her Far East commission, she sank 20 Japanese supply vessels – 19 by gunfire – together with a destroyer and four escorts. On her most successful patrol she sank 11 vessels, nine on a single day. Note that torpedoes were reserved for warships, gunfire sufficing to despatch cargo ships.*

'S' class (continued)



Specification

'S' class (later boats)
Displacement: 860 tons surfaced and 990 tons submerged
Dimensions: length 66.14 m (217.0 ft); beam 7.16 m (23.5 ft); draught 3.20 m (10.5 ft)
Propulsion: two diesels delivering 1416.8 kW (1,900 bhp) and two electric motors delivering 969.4 kW (1,300 hp) to two shafts
Speed: 15 kts surfaced and 9 kts submerged
Endurance: 13897 km (8,635 miles) at 10 kts surfaced
Armament: one 101.6-mm (4-in) gun and six 533-mm (21-in) torpedo tubes, or one 76.2-mm (3-in) gun and seven 533-mm torpedo tubes
Complement: 44

HMS* Sibyl *enters Algiers harbour in May 1943. Originally intended for operations in the Mediterranean and Baltic, 'S' class boats also found themselves in the East Indies. Sixty-two were produced, making them the largest class in the Royal Navy.

UK

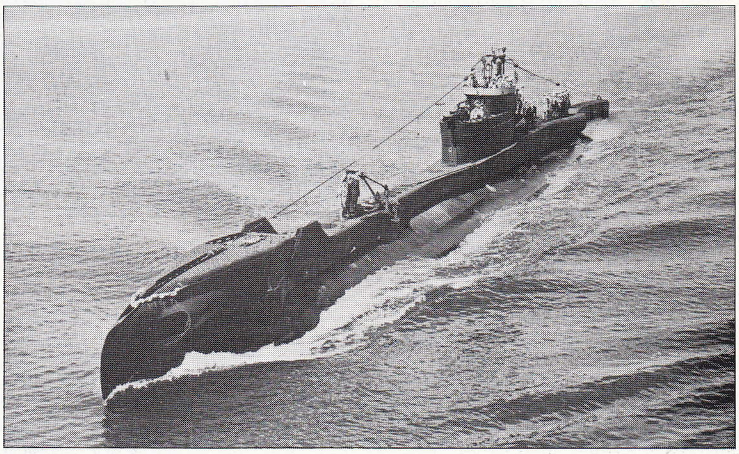
'T' class

Instantly recognizable as a result of their oddly cranked profiles, the **'T' class** boats were the Royal Navy's standard wartime patrol submarines. Between HMS ***Triton*** and ***Tabard***, launched in October 1937 and November 1945 respectively, the class reached a respectable 54 in number. With the 'Thames' class abandoned for the reasons discussed and a replacement required for the unsatisfactory 'O' class, the 'T' class design needed not only to rectify shortcomings but also to conform to the treaty agreements that bedevilled interwar planning. The London Naval Treaty limited total (rather than individual) displacement so, to obtain maximum numbers of boats, a 1,000-ton target was set. Into this a 42-day endurance was to be packed. That the final result was only some 9 per cent heavy, while being highly reliable, was a credit to the design team.

Because of their limiting parameters, the 'T' class boats could ship only small-sized diesels and their surface speed was thus modest. In contrast they carried a large punch, the six forward tubes within the pressure hull being augmented by a pair in the bulged bow casing and a further pair in the casing, one on each side of the tower. Thus, a 10-torpedo forward salvo could be fired, albeit at the cost of a highly individual profile.

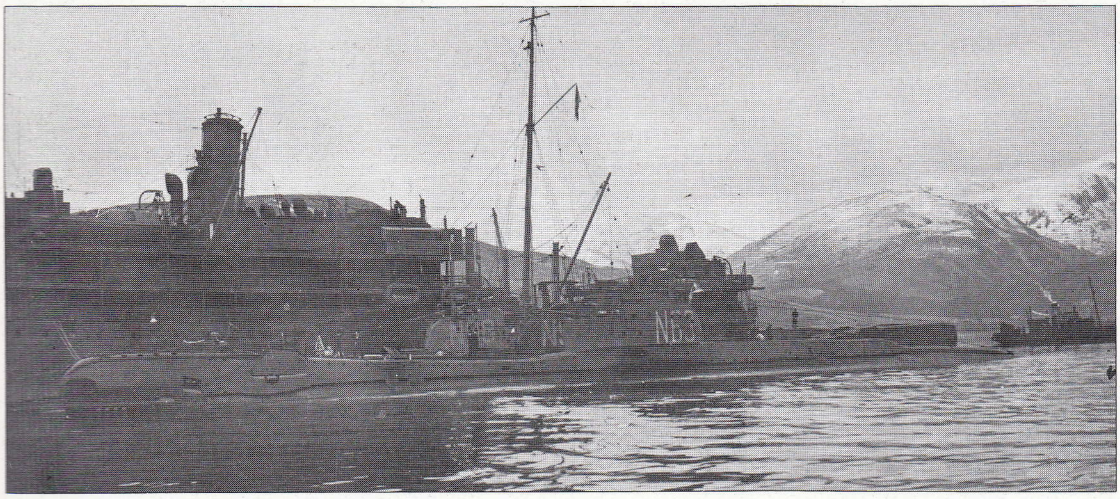
This arrangement applied to all 22 boats built before World War II, later units having the amidships tubes taken farther aft and reversed, and a single tube added in the casing right aft. War-built boats also had their bows altered to set the external tubes higher, and some external ballast tanks converted to bunker space. Oil fuel capacity was almost doubled and the endurance of the boat became more than that of her crew and their supplies.

Fourteen of the pre-war boats were lost, mainly in the Mediterranean. Those from the wartime programmes were completed largely after the end of the Mediterranean war and only one was lost at sea. Post-war many were sold, while others were stretched and streamlined, serving alongside their successors, the 'A' class, until the late 1960s. Four units were cancelled and another only projected.



Above: HMS* Tally-ho *in transit to the Far East. Such passages of the Bitter Lakes of the Suez canal had become more common in January 1945, with any German naval threat extinct and resources gradually being released for service against the Japanese.

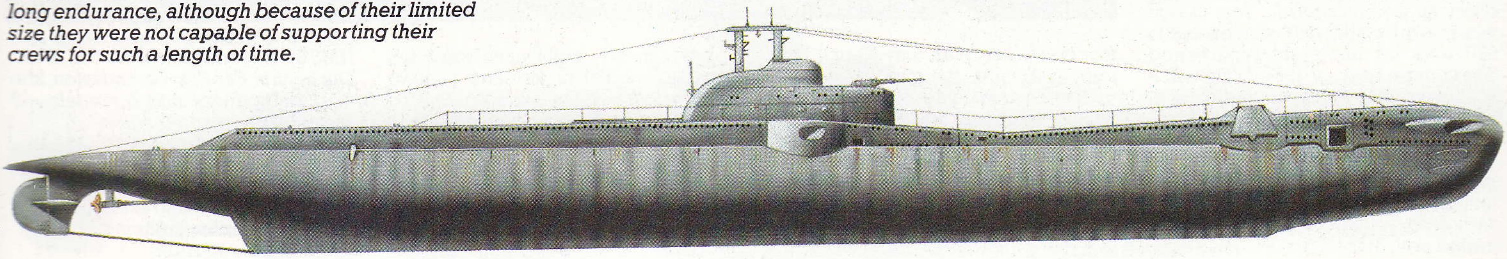
Below: HMS* Tigris *seen alongside a depot ship just before her final patrol. She was one of the original 'T' class boats, launched in October 1939, but she was lost in March 1943, probably to mines. Note the external tubes at the bow and amidships, and the unusual hull profile.



Specification

'T' class
Displacement: 1,325 tons surfaced and 1,570 tons submerged
Dimensions: length 83.82 m (275.0 ft); beam 8.10 m (26.58 ft); draught 4.50 m (14.75 ft)
Propulsion: two diesels delivering 1864.25 kW (2,500 bhp) and two electric motors delivering 1081.3 kW (1,450 hp) to two shafts
Speed: 15.25 kts surfaced and 9 kts submerged
Endurance: 20382 km (12,665 miles) at 10 kts surfaced
Armament: one 101.6-mm (4-in) gun and 10 or 11 533-mm (21-in) torpedo tubes (in first group 10 bow and in second group eight bow and three stern)
Complement: 56 (first group) or 61 (second group)

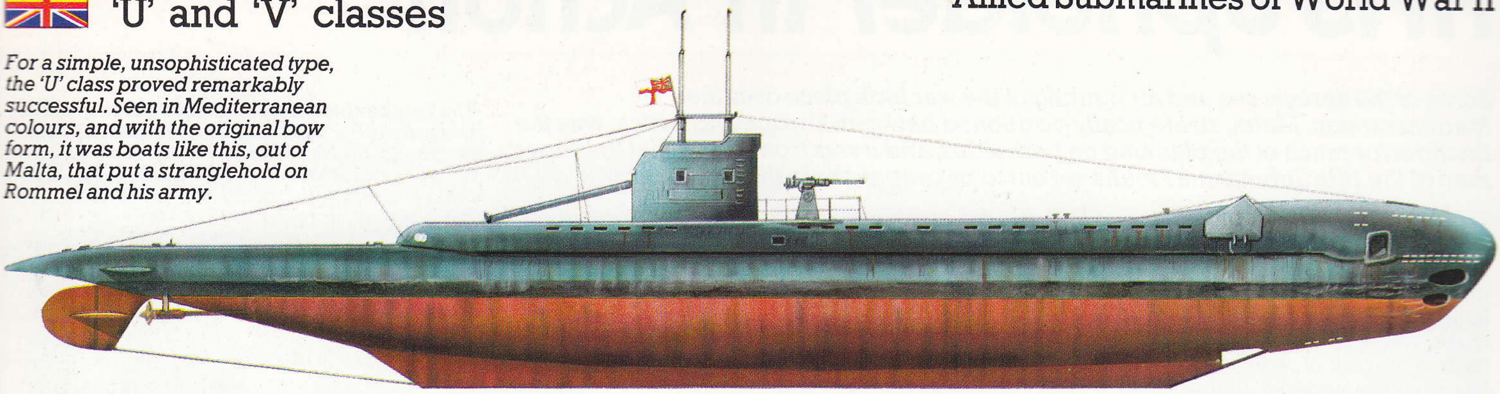
Below: The 'T' class 1940 designs were slow but of long endurance, although because of their limited size they were not capable of supporting their crews for such a length of time.



UK

'U' and 'V' classes

For a simple, unsophisticated type, the 'U' class proved remarkably successful. Seen in Mediterranean colours, and with the original bow form, it was boats like this, out of Malta, that put a stranglehold on Rommel and his army.



A successful type, the single-hulled **'U' class** boats were designed originally as unarmed targets to replace the elderly 'H' class boats, and were little larger. Three were laid down as such but, as the Royal Navy did not possess a modern 'coastal' submarine, it seemed advantageous to modify the bow to take torpedo tubes from the outset. The after hull had a sharp taper and the casing ended short of the stern, so all armament was set forward, four tubes in the pressure hull and, surprisingly (though a reflection on the doubtful accuracy of the torpedo salvoes of the day), the bow casing was also bulged to take two more. This was not a good feature as the restricted height of the design meant a shallow periscope depth, and the oversize bow casing made it both difficult to maintain constant depth and also caused a distinctive 'pressure hump' in the water above. With the outbreak of war a further group of 12 boats was ordered, 1.6 m (5.25 ft) longer to improve the lines and ease the cramped internals; most of these had only four tubes. Thirty-four more boats of this type followed, with improved lines and increased bunker space. Though extremely handy, the 'U' class boats were rather limited in diving depth and had a low surface speed.

Again, therefore, the design was updated. This time an extra midbody section was inserted to house uprated machinery, and the hull was redesigned to permit submergence to 91 m (300 ft) rather than the 60 m (200 ft) of the earlier boats, and to facilitate all-welded construction in modules that would produce faster building times. This later type was known as the **'V' class**, of which 33 were ordered but only 21 completed. It is a noteworthy fact that, except for two early units built in Chatham Dockyard, all 81 boats were built in the two Vickers Armstrong yards at Barrow and on Tyneside.

The 'U' and 'V' classes were particularly suited to the shallow and confined waters of the North Sea and Mediterranean but, though successful, they suffered 19 losses. After the end of the Mediterranean war they had little use and many were either transferred or reverted to a training role.

Specification
'V' class

Displacement: 670 tons surfaced and 740 tons submerged

Dimensions: length 62.79 m (206.0 ft); beam 4.88 m (16.0 ft); draught 4.72 m (15.5 ft)

Propulsion: two diesels delivering 596.6 kW (800 bhp) and two electric motors delivering 566.7 kW (760 hp) to two shafts

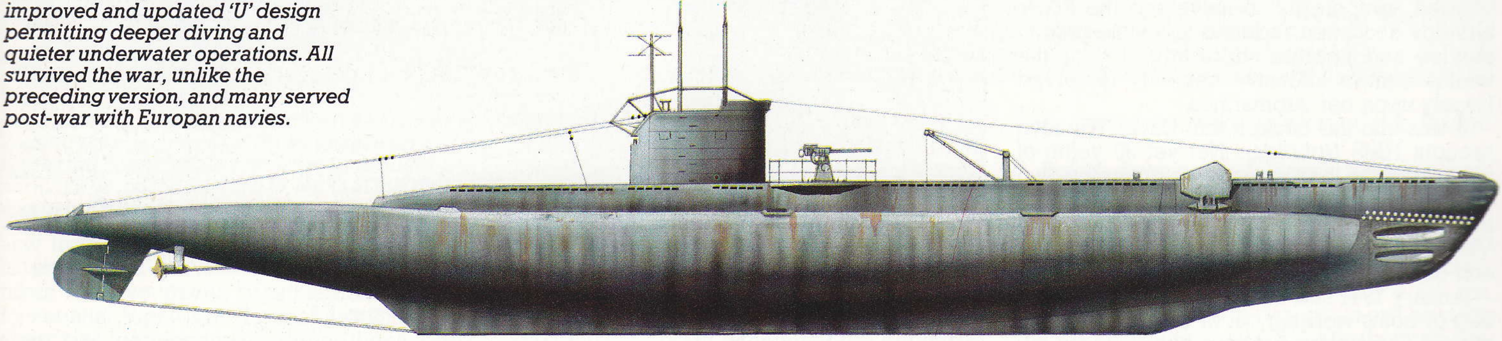
Speed: 12.5 kts surfaced and 9 kts submerged

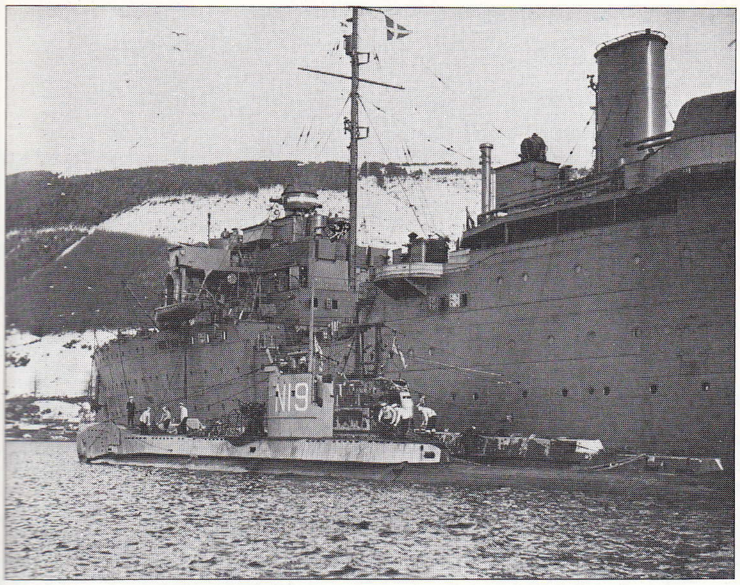
Endurance: 8715 km (5,415 miles) at 10 kts surfaced and 113 km (70 miles) at 7 kts submerged

Armament: one 76.2-mm (3-in) gun and four 533-mm (21-in) torpedo tubes (all bow) for eight torpedoes

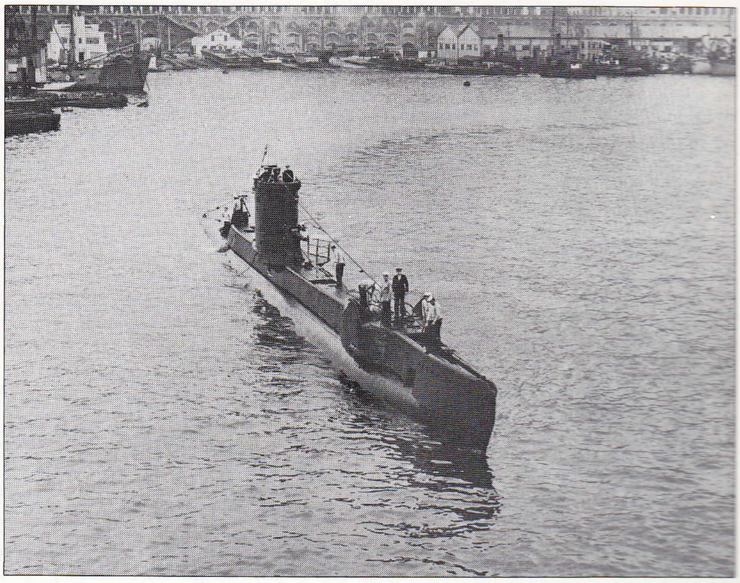
Complement: 37

The 'V' class represented an improved and updated 'U' design permitting deeper diving and quieter underwater operations. All survived the war, unlike the preceding version, and many served post-war with Europan navies.





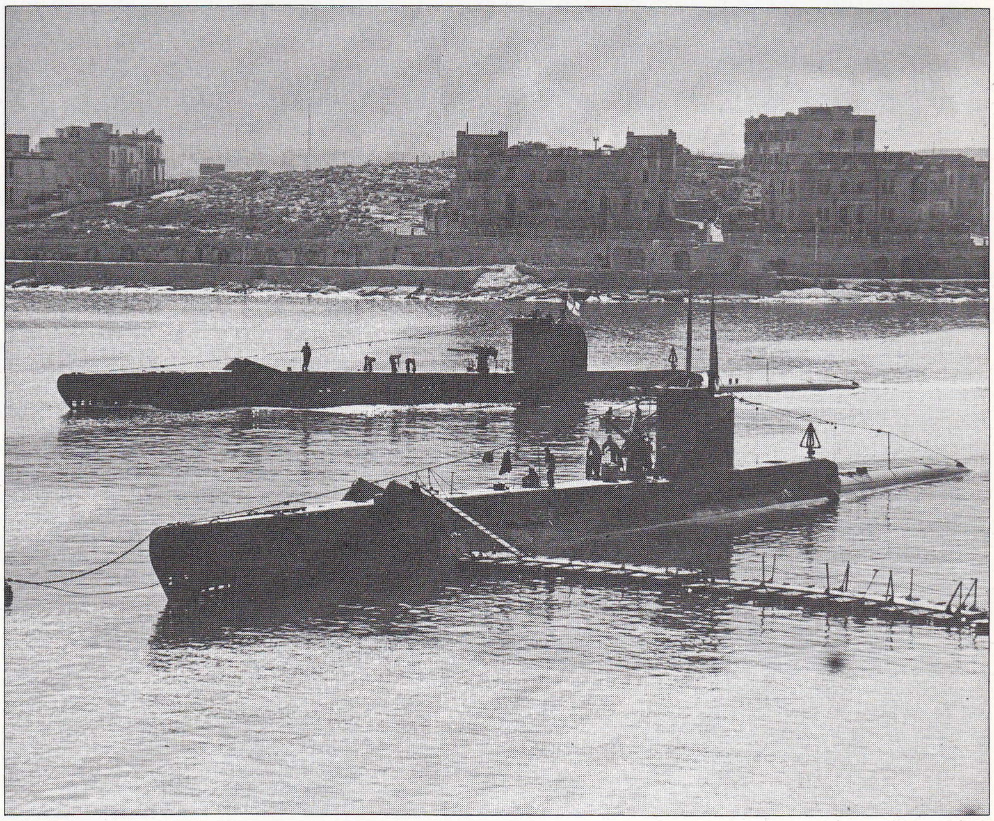
HMS Utmost *alongside a depot ship (either* Forth *or* Maidstone*) and the 'S' class boat* Seawolf*.* Utmost *had recently returned from a Mediterranean commission, during which she torpedoed the heavy cruiser* Trieste*, causing severe damage as well as sinking several supply vessels and also undertaking other clandestine operations.*



HMS Uproar *shows the small size of these boats. In a short-range war, such as in the North Sea or the Mediterranean, endurance is much less important than manoeuvrability, and the 'U' class proved very handy, in spite of having been designed as a training boat.*

HMS *Upholder* in Action

Some of the fiercest sea and air fighting of the war took place over the Mediterranean. Malta, strategically positioned between Europe and Africa, was the linchpin for much of the planning on both sides, and it was from Malta that the young men of the 10th Submarine Flotilla set out to put a spanner in the Axis works.



The Tenth Submarine Flotilla was based in the old Quarantine Harbour of Malta, away from the main anchorage of Grand Harbour. At the time when the flotilla was most active, there would have been few other vessels in port, being far too vulnerable to the incessant air raids.

Early 1941 saw Malta's tribulations increasing in direct proportion to her strategic significance. The newly-arrived German X Fliegerkorps was taking over from the Regia Aeronautica the task of reducing the island fortress to impotence and, despite the devoted efforts of the weary and supply-starved defenders, a permanent dust cloud hung over Valletta and its rubble-choked streets. Its magnificent and rambling Grand Harbour was virtually devoid of warships but, even so, the Royal Navy could not countenance falling back on the relative safety of Gibraltar and Alexandria, for these were critical times in the sea war.

Following their success against the Italians in North Africa, British land forces were being transferred in large numbers to fight the abortive campaigns of Greece and Crete. At the same time, however, Rommel's Afrika Korps and its equipment were being shipped to North Africa in a continuous flow of convoys. Malta was well placed both to interdict these and to assist in the covering of the British troop movements. The Luftwaffe's role was to prevent this and it had succeeded to the point where the Royal Navy's surface ships had been obliged, temporarily, to leave and the RAF's airfields had been reduced to a state unfit to service and operate strike aircraft. For the while, Malta's offensive capacity devolved largely upon her submarines.

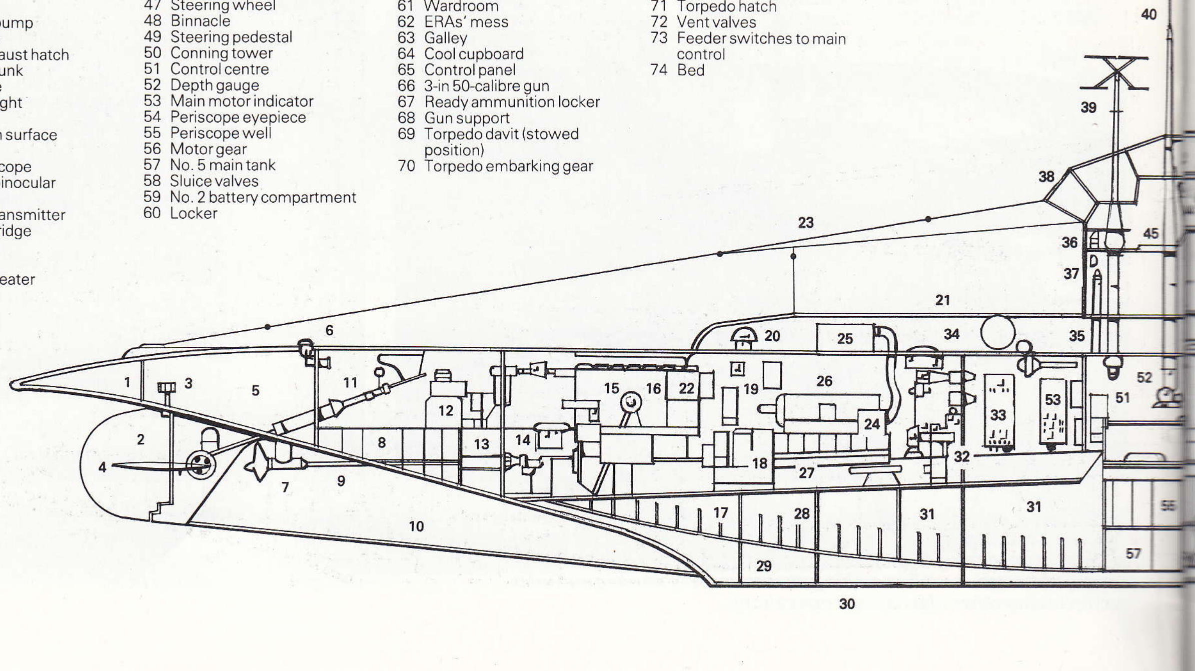
It was into this cockpit that David Wanklyn brought HMS *Upholder*. Not yet 30 years of age, Wanklyn had already commanded two old 'H' class boats in home waters before standing by his new submarine as it took shape on a Vickers' slip during 1940. He was to be her first and only commanding officer.

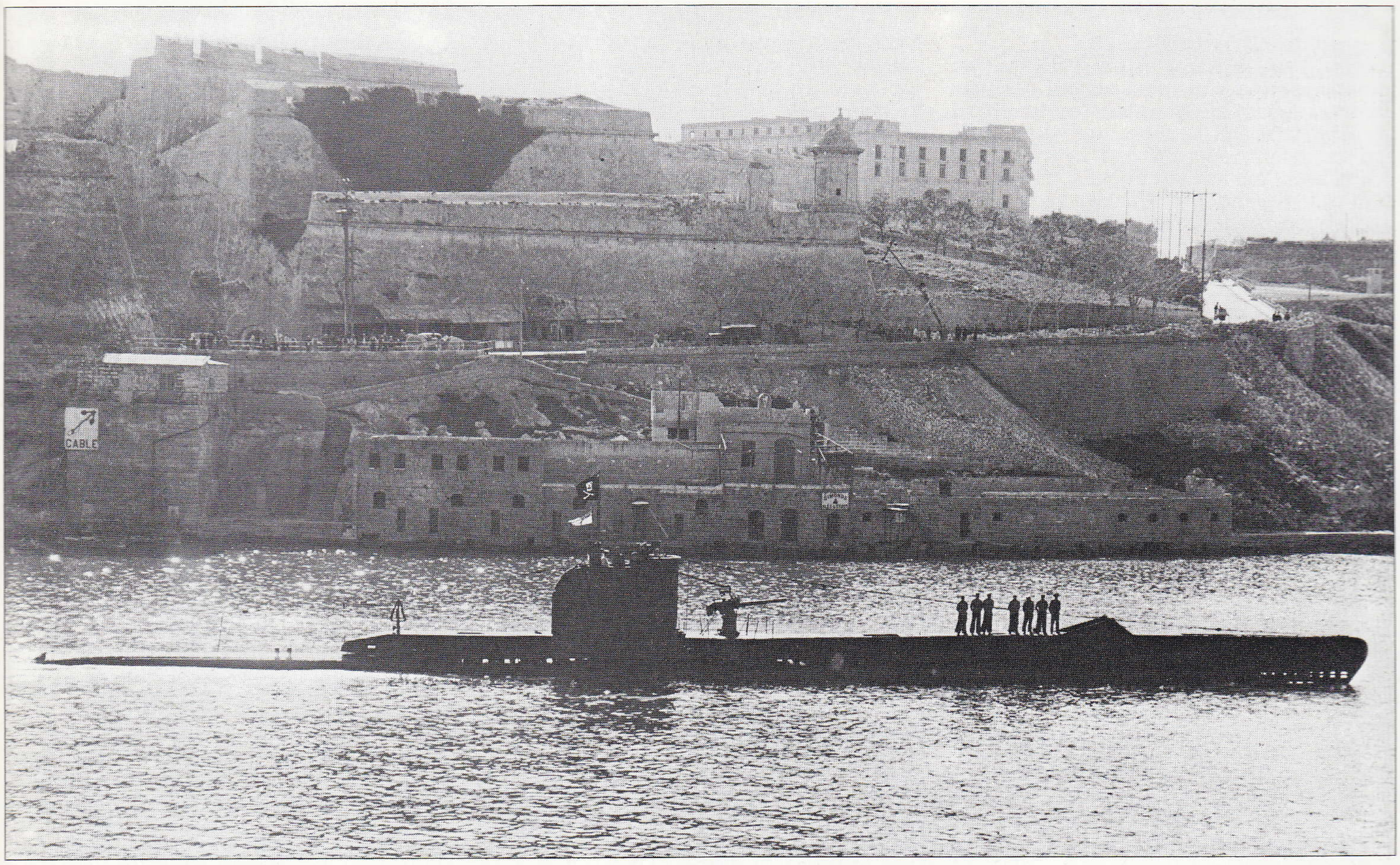
January 1941 saw the *Upholder* join a mixed bag of boats working out of Lazaretto Creek, the old Quarantine Harbour distanced by the Valletta Peninsula from the bustle of the Grand Harbour. Under the command of Captain 'Shrimp' Simpson, they were to be officially organized into the 10th Submarine Flotilla.

On 24 January, following voyage repairs, the *Upholder* sailed on her first combat patrol, accompanying three other boats. In pre-dawn blackness two days later, the little boat was lying on the surface awaiting the source of propeller noises heard clearly over the asdic (sonar). Sure enough, the vague shapes of three southbound merchantmen and their

'U' class submarine cutaway drawing key

1	Tailcone
2	Rudder
3	Spindle
4	Hydroplane
5	No. 6 main tank
6	Air vent valve
7	Screw (twin)
8	Compensating tank
9	Shaft
10	Anti-obstruction wire
11	Hydroplane gear
12	Air compressor
13	Store
14	Transmission locking gear
15	Starter
16	Port main motor
17	Lubricating tank
18	Port generator
19	Oil fuel gravity tank
20	Mooring line bollard
21	Outer casing
22	Switchboard
23	Wireless aerials
24	Exhaust cut-off valve
25	Engine exhaust
26	Port main engine
27	Oil cooler
28	Framing
29	Lead ballast
30	Compensating tank
31	Oil fuel
32	Circulating pump
33	W/T cabinet
34	Surface exhaust hatch
35	W/T aerial trunk
36	Hydrophone
37	Navigation light
38	Handrail
39	RDF array (in surface position)
40	Attack periscope
41	8-in bifocal binocular periscope
42	Telegraph transmitter
43	Telegraph bridge
44	Bow light
45	Hatch
46	Azimuth repeater
47	Steering wheel
48	Binnacle
49	Steering pedestal
50	Conning tower
51	Control centre
52	Depth gauge
53	Main motor indicator
54	Periscope eyepiece
55	Periscope well
56	Motor gear
57	No. 5 main tank
58	Sluice valves
59	No. 2 battery compartment
60	Locker
61	Wardroom
62	ERAs' mess
63	Galley
64	Cool cupboard
65	Control panel
66	3-in 50-calibre gun
67	Ready ammunition locker
68	Gun support
69	Torpedo davit (stowed position)
70	Torpedo embarking gear
71	Torpedo hatch
72	Vent valves
73	Feeder switches to main control
74	Bed

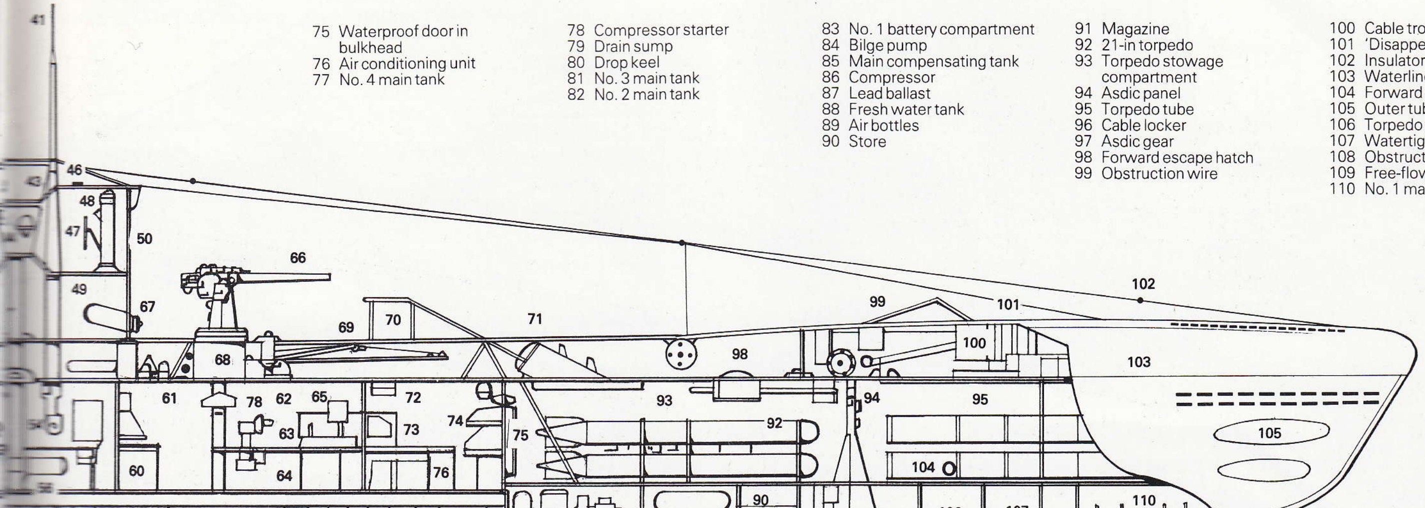




The Fortress of St John, dominating the harbours of Valetta, welcomes home a 'U' class boat after a successful patrol. While a return to base might normally be looked forward to, Malta at this time was being subjected to punishing air raids from Axis bases only 20 minutes' flying time away.

single escort reluctantly detached themselves from the deep gloom. Wanklyn loosed a full spread of four torpedoes. All missed, the enemy sailing serenely on, oblivious of their assailant. Chagrined, the *Upholder*'s crew reloaded and sweated out the day on the bottom. Torpedoes in Malta were like summer snow and their wastage was not popular. With darkness came the welcome order to surface, to recharge batteries and refresh the boat's foul atmosphere. She was astride the main Trapani-Tripoli route and targets abounded; unfortunately a group of three passing merchantmen were northbound in ballast and the remaining four torpedoes were conserved for loaded targets.

Before dawn on the following morning came a chance with two heavily-laden targets trundling south over a calm sea. Two shots produced the *Upholder*'s first hit: the 4,000-tonner settled slowly by the bows as her companion bore on. Wanklyn was determined to verify a kill but, not daring to surface in daylight to use his deck gun yet unwilling to sacrifice a further torpedo,



75 Waterproof door in bulkhead
76 Air conditioning unit
77 No. 4 main tank
78 Compressor starter
79 Drain sump
80 Drop keel
81 No. 3 main tank
82 No. 2 main tank
83 No. 1 battery compartment
84 Bilge pump
85 Main compensating tank
86 Compressor
87 Lead ballast
88 Fresh water tank
89 Air bottles
90 Store
91 Magazine
92 21-in torpedo
93 Torpedo stowage compartment
94 Asdic panel
95 Torpedo tube
96 Cable locker
97 Asdic gear
98 Forward escape hatch
99 Obstruction wire
100 Cable trough
101 'Disappearing' bollards
102 Insulator
103 Waterline (surface trim)
104 Forward hydrophone
105 Outer tube covers
106 Torpedo operating tank
107 Watertight tank
108 Obstruction rod
109 Free-flowing valves
110 No. 1 main tank

hung around for hours until the reluctant victim plunged quietly and without fuss.

It was to be 48 hours later that the final two torpedoes were expended against a single, escorted target. One hit was scored, which did not prove fatal, and the submarine was soundly and accurately depth charged. By a combination of silent routine and frequent changes in both course and depth, Wanklyn successfully disengaged, the destroyer giving up to succour her injured charge.

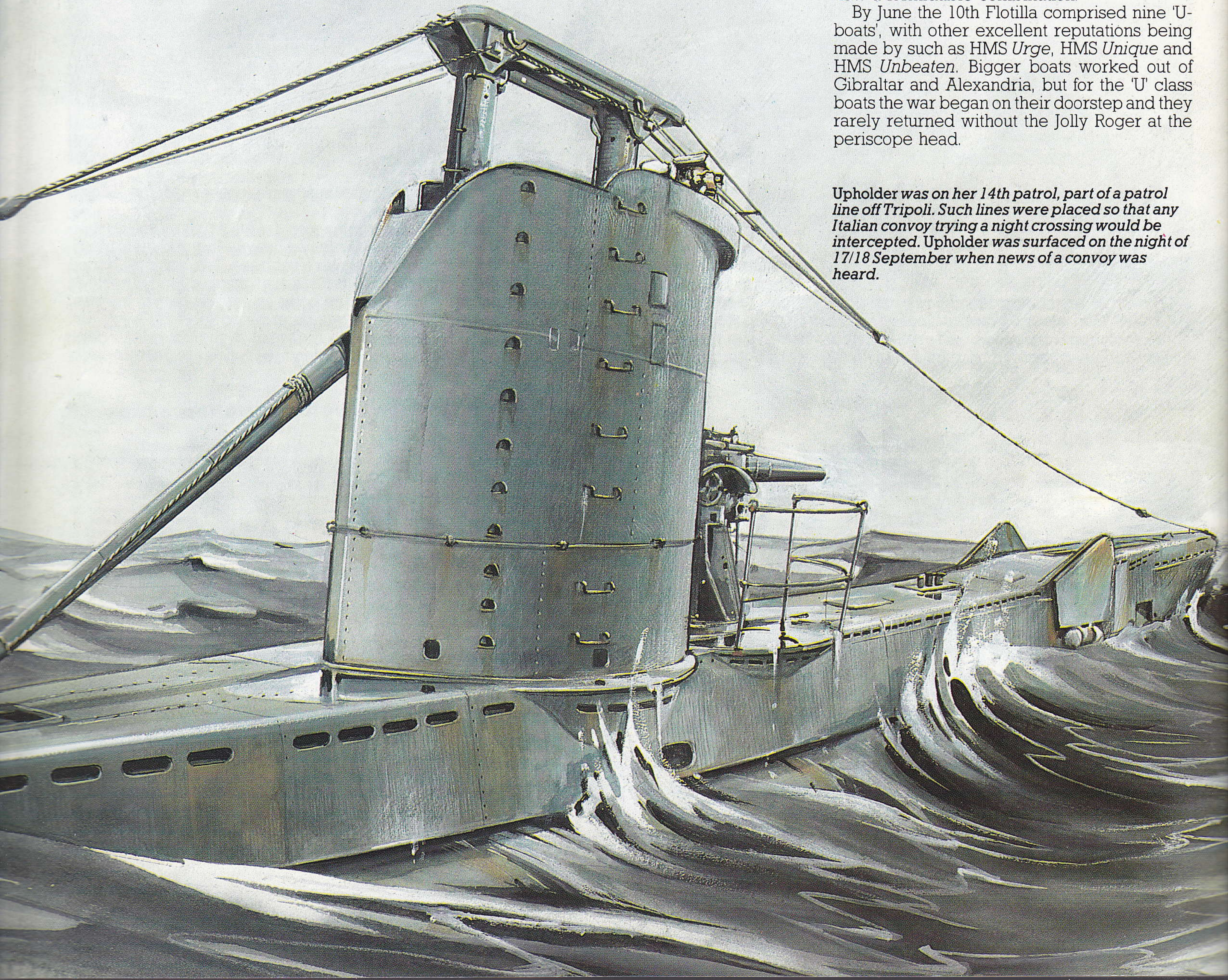
Still very much at the learning stage, the submarine entered a lean spell and it was not until the end of April that her score was boosted with a 5,500-tonner. Anxious to do better, Wanklyn nearly stranded the boat in destroying a loaded freighter abandoned on the Kerkenah Bank.

This was a time of little respite for the Malta boats, who lost two of their number in May. On 25 May the *Upholder* was in quiet conditions east of Sicily, having disposed of a 5,000-ton freighter in the Messina Strait during the day before, when hydrophone effect prompted a periscope check. What Wanklyn saw was a submariner's dream: four southbound liners, packed with troops. Unfortunately, they were accompanied by an alert escort of five destroyers and the *Upholder* was down to her last two torpedoes. Both had to count and an attacking position had to be achieved rapidly. Concentrating hard, Wanklyn was surprised by the urgent beat of an escort at close quarters. Only by an immediate flooding of the 'Q' tanks was the submarine able to gain sufficient depth to avoid being struck. Levelling out at 24 m (80 ft) the fugitives were grateful to discover that they had not, in fact, been detected. Time, however, had been lost and the boat was back to periscope depth immediately; both torpedoes were loosed at a two-funnelled ship as the *Upholder* again plummetted and changed course. Skippers who survived never dallied to observe results! Two explosions were clearly audible at the appointed time but the escort ran down the torpedo tracks and heavily depth-charged the release area. The *Upholder* was still perilously close to this point but, resisting the temptation to break into a noisy gallop, Wanklyn slowly put distance between himself and what was an unco-ordinated assault.

Victoria Cross

Reaching Malta without damage, he discovered that he had despatched the liner *Conte Rosso* (17,879 grt). Of the 2,500 troops aboard, over 800 perished; the remainder of the convoy promptly reversed course. For his coolness and achievement, Wanklyn was awarded the Victoria Cross. He, his crew and his boat were now a formidable combination.

By June the 10th Flotilla comprised nine 'U-boats', with other excellent reputations being made by such as HMS *Urge*, HMS *Unique* and HMS *Unbeaten*. Bigger boats worked out of Gibraltar and Alexandria, but for the 'U' class boats the war began on their doorstep and they rarely returned without the Jolly Roger at the periscope head.



Upholder *was on her 14th patrol, part of a patrol line off Tripoli. Such lines were placed so that any Italian convoy trying a night crossing would be intercepted.* Upholder *was surfaced on the night of 17/18 September when news of a convoy was heard.*

Lieutenant-Commander M.D. Wanklyn VC, DSO, is seen with his Number One, Lieutenant J.R. Drummond, flanked by Upholder's *officers. The bearded Wanklyn and his crew established such a reputation that the name ship of the modern Type 2400 class is to be called* Upholder.

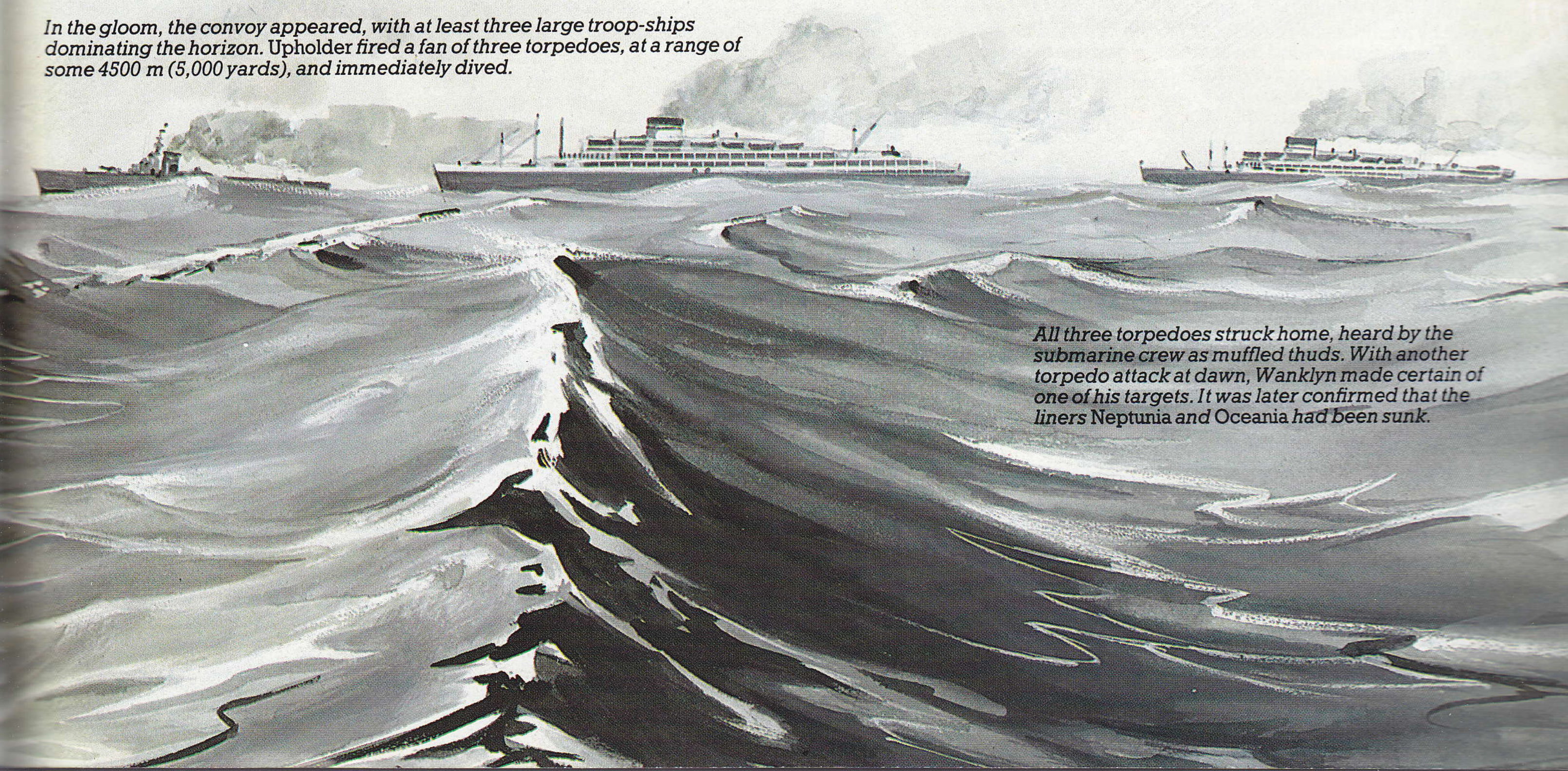
On 28 July 1941, near Marittimo, the *Upholder* put two torpedoes into the cruiser *Garibaldi* without, however, sinking her. A month later, on 22 August as she was picking off a 4,000-tonner from a convoy, the *Unique* was sinking the 11,400-ton *Esperia*, a survivor of the earlier troop convoy. Shortly after, on her 14th patrol, the *Upholder* was part of a submarine line off Tripoli, a trap to intercept three more large troopships. In the early hours of 18 September, surfaced with casing awash, she received warning of the convoy's approach from the *Unbeaten*, the next in line. With the Italians having no radar, it was possible to remain surfaced, with the sound gear giving a rough bearing. Vague shadows, barely separable from the general gloom, the enemy duly appeared, moving fast. Long prepared, Wanklyn fired three torpedoes at an estimated 4570 m (5,000 yards) and dived fast. Men mentally counted off seconds until a muffled thud released held breath. Smiles erupted into cheers when, immediately afterward, two more explosions were heard. A full house. Still there came no counterattack and a cautious peep with the periscope was made as the crew wrestled and cursed silently in the task of reloading. Destroyers appeared to be engaged in rescuing survivors while the stationary bulk of a liner loomed nearby. Dawn confirmed the situation, with the added problem of a destroyer circling protectively but as yet blindly. Of the third liner there was no sign. Though once forced down by the escort, the *Upholder* was worked slowly, patiently, into an attack position and, as the morning sun shone yellow on its plates, the immobilized trooper was lifted by the simultaneous eruption of torpedoes. As though weary of further struggle she quietly slid under. The *Upholder* had disposed of the 19,500-ton sisters *Neptunia* and *Oceania*. The third ship, *Vulcania*, evaded an attack by HMS *Ursula* to make Tripoli safely.

Though now credited with over 100,000 grt sunk, the boat was now to experience two totally uneventful patrols. In early November 1941, however, an improvement in the situation in Malta allowed the surface ships of Force K to operate for a while. They totally destroyed one convoy, together with an escort, and the *Upholder* (ever the opportunist) encountered the aftermath and added a further destroyer, the *Libeccio*, to the list. Rommel, now desperate for supplies, pressured the Italians to the point where warships were used as transports. The *Upholder* encountered, and despatched in a mighty detonation, the petrol-laden Italian submarine *St Bon*.

Final patrol

Following a necessary spell ashore in early 1942, Wanklyn rejoined his command and sank a second submarine, the *Tricheco*, in the Strait of Otranto, heavy weather then frustrating an attack on enemy capital ships.

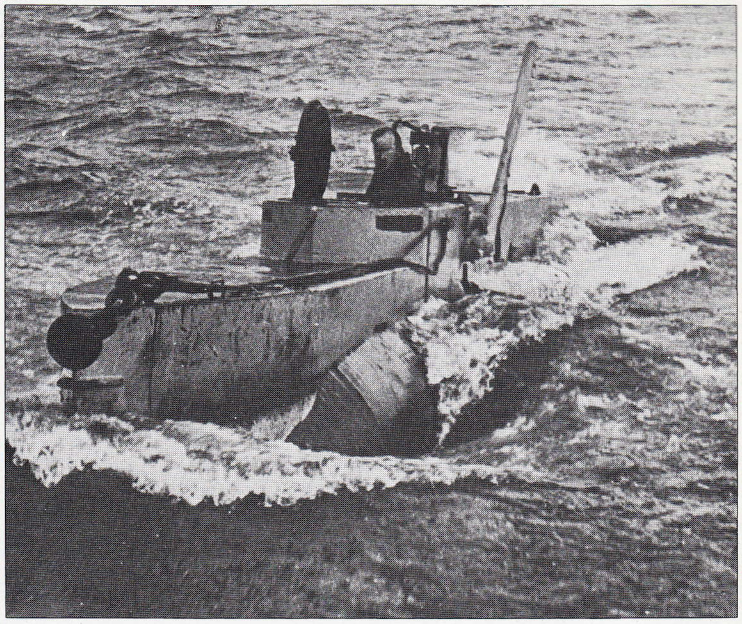
On 6 April 1942 the *Upholder* sailed on her 25th patrol. She landed an agent ashore and transferred another to HMS *Unbeaten* before proceeding to her usual patch off Tripoli. She was never seen again. Other boats in the area heard a prolonged depth charge attack and the Italians credited their destroyer *Pegaso* with a positive kill. Wanklyn and his dedicated crew had made their last contribution to the unremitting blockade that was to guarantee the defeat of the Afrika Korps in the battles around El Alamein only six months later.



In the gloom, the convoy appeared, with at least three large troop-ships dominating the horizon. Upholder *fired a fan of three torpedoes, at a range of some 4500 m (5,000 yards), and immediately dived.*

All three torpedoes struck home, heard by the submarine crew as muffled thuds. With another torpedo attack at dawn, Wanklyn made certain of one of his targets. It was later confirmed that the liners Neptunia *and* Oceania *had been sunk.*

'X'-craft versus the *Tirpitz*



One of the 'X'-craft which attacked the Tirpitz*, in a photo taken while training for the attack. The 35-ton craft were towed by larger submarines to the northern tip of Norway, where the crews that were to make the attack were exchanged with the passage crews. The six tiny vessels then set off alone.*

From January 1942, when she arrived new from her builders, until her eventual destruction by bombing in November 1944, the battleship *Tirpitz* remained in Norwegian waters almost continuously, rarely moving yet posing a real threat to the precarious northern convoy route, a threat too distant to easily eradicate. The concern that she was at sea prompted the scattering of PQ17, and the raid on St Nazaire was mounted to deny her a graving dock on the Atlantic coast. What could not be achieved by frontal assault the British chose to accomplish through guile, developing the 35-ton midget submarine, known as an 'X'-craft, primarily for the purpose of destroying her.

In April 1943, a half-dozen of these craft, with base facilities, were installed in a remote western Scottish loch to exercise intensively in penetrating net and boom defences, in using divers and in the accurate placement of the two-ton explosive charges that constituted their main weapon. Simultaneous attacks were planned on the *Tirpitz*, *Scharnhorst* and *Lützow*, all of which were using protected anchorages around the Altenfjord, hard by North Cape.

On the night of 11/12 September 1943, six patrol submarines left the loch, each towing an 'X'-craft manned by a passage crew for the long haul northward. Broken towlines were all too common, one resulting in the total disappearance of *X9*. Leaks in *X8* obliged her scuttling to avoid delay to the enterprise, while *X7* was amazingly fortunate to actually impale a floating mine with her bows without causing its detonation.

After a nine-day passage, and having embarked their attack crews, the four surviving craft left their parent submarines on the night of the 20/21 September, crossed the offshore minefield on the surface and entered the long fjord. Not until the day after did the three craft tasked with attacking the *Tirpitz* arrive at her Kaafjord anchorage. With some difficulty they forced the nets, but *X6* had a faulty compass and a virtually jammed periscope. Effectively blinded, her skipper (Lieutenant Cameron) inadvertently broached while forcing the battleship's inner net defence. Though sighted, he was too close to be engaged by other than grenades and small-arms fire. Blundering into his target, Cameron released his charges, surfaced, scuttled and baled out. All aboard were captured.

The Germans made rapid preparations to get under way but then sighted *X7* (Lieutenant Place) and decided to stay within the anti-torpedo nets, compromising by veering anchor cable to shift position. Place, however, had planted a charge under each end of his mighty adversary. When the first detonated, it countermined the remainder in one enormous explosion.

At the time *X7* was still negotiating the inner net on her way out and was heavily damaged. She broke clear but foundered, two of her four crew being lost. *X5* was not seen after the initial approach: there is no evidence that she was able to attack and the German claim to have sunk her by gunfire about 30 minutes after the main action may well be true.

The fourth craft, *X10*, scheduled to attack the *Scharnhorst*, also suffered compass and periscope failure. After trying unsuccessfully to rectify these, her skipper aborted his plans and sailed to meet his parent submarine offshore. The craft had eventually to be scuttled in a gale.

For the cost of six 'X'-craft and 10 gallant lives, the *Tirpitz* was sorely damaged. Much machinery was unseated and misaligned by the shock of the explosion and, though partially repaired, the ship was never again fully battle-worthy. For their parts, both Cameron and Place were awarded the Victoria Cross.

UK

'X'-craft

Though popular with some foreign fleets, the concept of the midget submarine had no part in the Royal Navy's pre-war plans. Only in 1942 did it become apparent that no orthodox method existed to strike at enemy ships that menaced the northern convoy route from safe, protected anchorages. Two prototype **'X' type** midgets (*X3* and *X4*), based on a private design, were quickly built and tested, followed by a production run of six (***X5*** to ***X10***). The design avoided the snare of over-miniaturization and the 15.62-m (51.25-ft) craft could support a volunteer crew of four for several days. A distinctive feature was the armament, not torpedoes but two large charges, conformal with the hull and each containing 2 tons of explosive. These could be deposited on the seabed below a stationary target or, if the water was too deep, slung beneath it. A key member of the crew was the diver, who could leave and re-enter the craft by a floodable forward compartment. It was he who secured the lines for the neutrally buoyant charges or placed limpet mines actually on the target's hull.

Though theoretically capable of an independent range of 2776 km (1,725 miles), this would have involved a long and endurance-sapping test for the crew and it was, therefore, customary to tow them with large submarines to the neighbourhood of their attack.

Twelve production 'X'-craft were built (including the training units ***XT1*** to ***XT6***), of which seven were lost. They were followed by a slightly larger **'XE' type** for use in the Far East and equipped with a rudimentary, but very welcome, air-conditioning system. Eleven of the 12 ordered (***XE1*** to ***XE12***) were completed, and one of these was lost.

The job for which the 'X'-craft were designed succeeded magnificently, their attack on the *Tirpitz* in September 1943 being related above. The Japanese cruiser *Takao* was sunk by a single 'XE'-craft in the Johore Strait in water so shallow that the submarine was in danger of being trapped between the cruiser and seabed as the tide receded. 'X'-craft reconnoitred and provided navigational aids for the D-Day beaches, sank a floating dock in Bergen and cut underwater cables in the Far East.

Specification

'X' class

Displacement: 27 tons surfaced and 29.5 tons submerged

Dimensions: length 15.62 m (51.25 ft); beam 1.75 m (5.75 ft); draught 2.26 m (7.42 ft)

Propulsion: one diesel delivering 31.3 kW (42 bhp) and one electric motor delivering 22.4 kW (30 hp) to one shaft

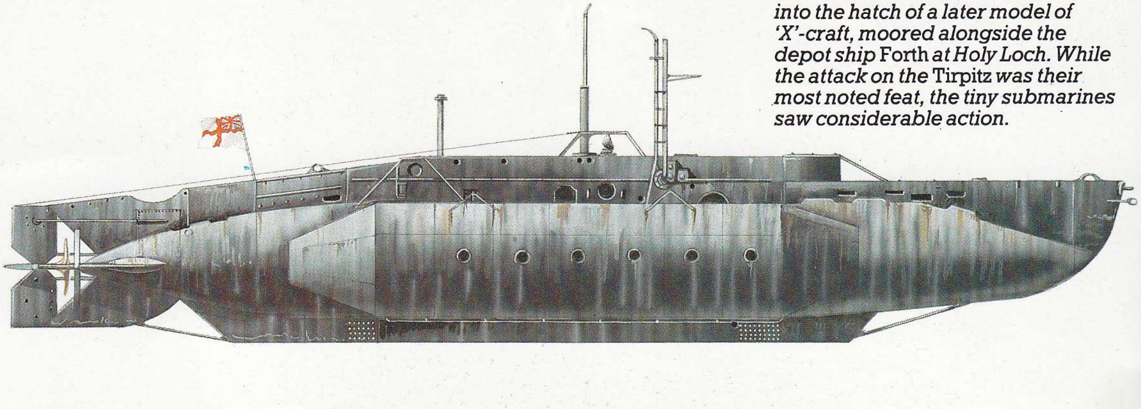
Speed: 6.5 kts surfaced and 5 kts submerged

Endurance: 2776 km (1,725 miles) at 4 kts surfaced and 148 km (92 miles) at 2 kts submerged

Armament: two 2-ton explosive charges and limpet mines

Complement: 4

Above: Rear Admiral C.B. Barry, Flag Officer Submarines, lowers himself into the hatch of a later model of 'X'-craft, moored alongside the depot ship Forth *at Holy Loch. While the attack on the* Tirpitz *was their most noted feat, the tiny submarines saw considerable action.*



One of the 'X'-craft which attacked the Tirpitz*,* X5 *is depicted showing one of the two conformal explosive charges, each of two tons.* X5 *was one of the unfortunate boats, as she was not heard from again after setting off.*

Warsaw Pact

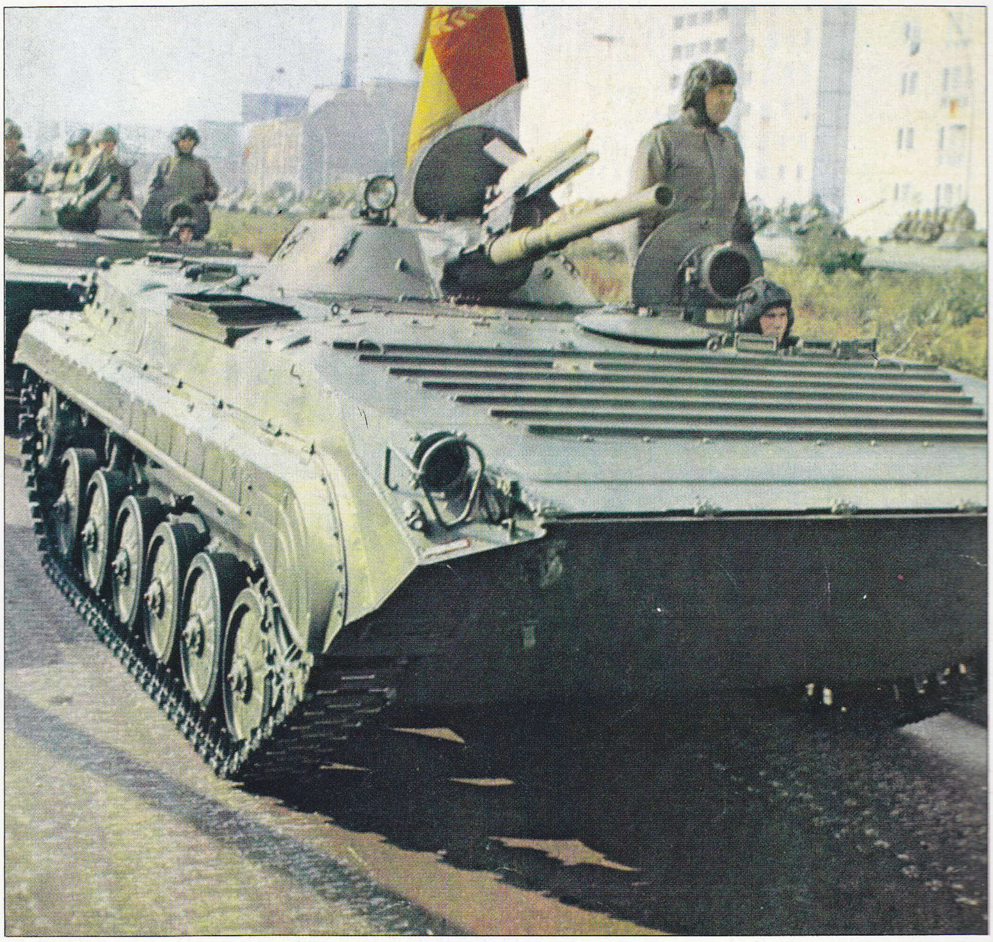
Part 1

East Germany

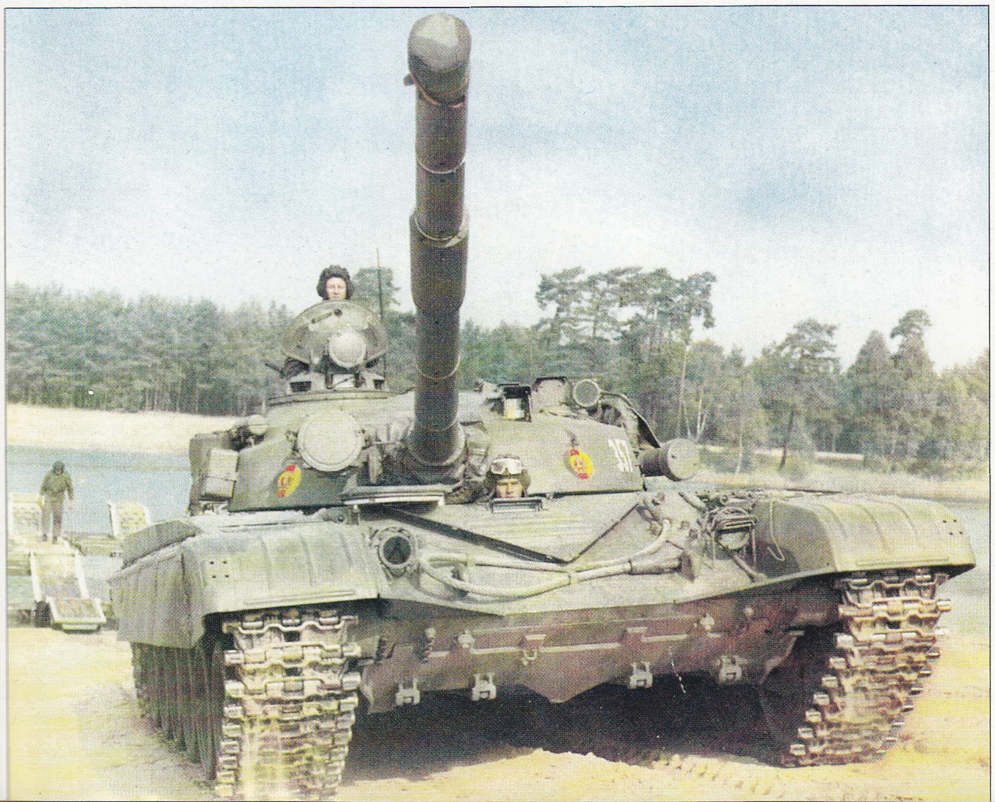
East Germany, or the German Democratic Republic (GDR) as it is officially called, plays a crucial role in the Warsaw Pact order of battle for two reasons: not only is it opposite West Germany, but within its borders is based the Group of Soviet Forces in Germany (GSFG). This latter is the largest concentration of Soviet forces outside the Soviet Union. The GSFG consists of 10 tank divisions, nine motorized rifle divisions and one artillery division.

After the end of World War II Germany was divided into four zones of occupation, one each administered by the Soviet Union, United States, United Kingdom and France. Berlin, which was within the Soviet zone, was also divided into four zones. The original intention was that the whole of Germany would be treated as a unity in economic terms, but this intention soon fell by the wayside as the Soviets moved countless key factories and their workers back to the Soviet Union as part of their war reparations programme. Conditions in the Soviet zone became steadily worse, and many workers and their families fled to the Western-administered zones. With the creation of a 4-km (2.5-mile) wide border zone this egress became very difficult, although people could still escape via Berlin. In June 1953 East Berlin workers revolted, but were soon quelled by the Soviet army with heavy loss of life. In 1954 the Soviets decided to cancel the reparation payments from Germany, although by that time there was in any case little left to take. Things started slowly to improve for eastern Germany, but many key workers were still fleeing to the west.

One night in August 1961 a barbed-wire barricade was erected around West Berlin (the US, British and French zones), and work soon started on its replacement by a more permanent structure, which later became the Berlin Wall. Since then the number of people escaping to the West has dropped to a trickle.



Above: The BMP-1 is armed with AT-3 'Sagger' anti-tank guided missiles and a 73-mm gun.



Left: The East Germans have recently begun to receive T-72 MBTs. This is a T-72 model 1980/81 which lacks the optical rangefinder forward of the commander's cupola, probably indicating that it carries a laser rangefinder.

The whole of the East German armed forces is called the Nationale Volksarmee (NVA, or National People's Army) and comprises the army, navy, air force and border commands. Their formation can be traced back to the early days after the end of World War II, when some Germans were used by the Allies for guard duties. In 1946 the East German Border Police was formed. When the German Democratic Republic was established in 1948 some of these police, together with German prisoners of war returning from the Soviet Union, were grouped into so-called Alert Units. As the years went by these grew in strength and most of their training was of a military rather than police nature. Eventually the name Alert Unit was dropped in favour of the Kasernierte Volkspolizei (KVP, or Garrisoned People's Police), which by then included land, sea and air units with a very high percentage of officers and NCOs.

12 PASS

In 1952 the KVP units were disbanded in favour of standard divisions, each of the two corps having three divisions, with a seventh division in East Berlin under operational control of the Ministry of the Interior. Two years later control of the KVP passed from the Ministry of the Interior to the Chief Administration of the German People's Police, and in 1956 the National People's Army was formed, although by that time the KVP had well over 110,000 officers and men under arms.

East German Army

The East German army has a strength of about 120,000 officers and men, of whom some 71,000 are conscripts. East Germany was in fact the last member of the Warsaw Pact to introduce conscription, in this case during 1962. Conscripts serve 18 months in the army and air force or 36 in the navy. Reserves amount to 330,000 with a three months per year call-up commitment, plus another 250,000 with a reduced commitment.

East Germany has two military districts, Military District III with its headquarters at Leipzig in the south and Military District V with headquarters at Neubrandenburg in the north. The East German army has six front-line divisions (two tank and four motorized rifle) organized along similar lines to those of the Soviet army, though all are manned and equipped as Category 1 units. Three of the divisions are based in the northern area: the 9th Tank Division near Eggesin, the 8th Motorized Rifle Division around Schwerin, and the 1st Motorized Rifle Division in East Berlin. The other three divisions are based in southern Germany: the 7th Tank Division near Dresden, the 4th Motorized Rifle Division near Erfurt, and the 11th Motorized Rifle Division near Halle.

The East German army also has two surface-to-surface missile brigades equipped with 'Scud' missiles (though the nuclear warheads for these weapons remain firmly under Soviet control), two air-defence regiments with SA-4 'Ganef' SAMs, two artillery brigades, two anti-aircraft regiments, three signals regiments, three engineer regiments, one airborne battalion and two anti-tank battalions.

Equipment includes 1,500 T-54/T-55 MBTs, a few T-62 MBTs, several hundred T-72/T-74 MBTs, over 1,500 T-34/85 tanks which are in reserve or used for training, 1,000 BMP mechanized infantry combat vehicles, 1,000 BRDM-1/BRDM-2 amphibious scout cars, about 1,600 BTR-60, BTR-70, BTR-50 and BTR-152 armoured personnel carriers, MT-LB multi-purpose tracked vehicles, about 600 towed and self-propelled artillery weapons including the 122-mm (4.8-in) 2S1 and 152-mm (6-in) 2S3 self-propelled howitzers, 150 or more 122-mm BM-21 (40-round) and 122-mm RM-70 (40-round) multiple rocket-launchers, 18 'Scud' SSM launchers and 24 FROG-7 missile launchers. Anti-tank weapons include the 'Sagger' (man-portable and vehicle-mounted), 'Spigot' (man-portable) and 'Spandrel' (vehicle-mounted) anti-tank guided missiles, as well as 100-mm (3.9-in) T-12 anti-tank guns. Air-defence weapons include 23-mm ZSU-23-4 and 57-mm ZSU-57-2 self-propelled anti-aircraft guns, 14.5-mm, 23-mm, 57-mm and 100-mm towed anti-aircraft guns, and SA-4, SA-6, SA-7 and SA-9 surface-to-air missile systems.

East German Navy

The East German navy has a total strength of 14,600 officers and men, though this figure does include the 2,800 men of the Grenze Brigade Kuste (GBK), the coastal branch of the frontier guard; the naval air arm with two helicopter squadrons including one with Mil Mi-14 'Haze' anti-submarine helicopters; and the 4,000 men manning coastal defence weapons including guns and 'Samlet' surface-to-surface missiles. The East German navy does not have any submarines, and its surface fleet includes two 'Koni' class frigates, 10 'Parchim' class corvettes, six 'Hai III' class large patrol craft (being replaced by the 'Parchim' class), 15 'Osa I' class fast attack craft (missile), 18 'Shershen' class fast attack craft (torpedo), 31 'Libelle' class fast attack craft (torpedo), 12 'Frösch' class LSTs, 27 'Kondor II' class minesweepers and a host of survey ships, diving tenders, intelligence craft, support ships and tenders. Reserves total 25,000 men.

East German Air Force

The East German air force has a manpower of 38,000 officers and men, of whom 15,000 are conscripts, and its strength is about 350 combat aircraft. The main role of the air force is close air support and air defence. Units include 18 air-defence squadrons with Mikoyan-Gurevich MiG-21 and MiG-23 fighters, one reconnaissance squadron with MiG-21s, four fighter/ground-attack squadrons with MiG-17s and MiG-23s, three transport squadrons with Antonov An-2, An-14 and An-26, Tupolev Tu-134 and Ilyushin Il-14 aircraft, two helicopter squadrons with Mil Mi-8 and Mi-24 helicopters, and a variety of trainers. The air force also controls two radar regiments and seven SAM regiments located at 30 surface-to-air missile sites with SA-2 and SA-3 missiles. Reserves total 30,000 men.

East German para-military units

The 50,000 East German frontier troops come under the Ministry of Defence and comprise some 66 battalions. There is also a coastal arm with 19 'Kondor I' class patrol craft, 14 'Bremse' class patrol craft and 30 to 40 smaller craft. The Ministry of State Security has about 7,000 men formed into a guard regiment in East Berlin with seven (six motorized rifle and one artillery) battalions. The Workers' Militia has about 450,000 people on mobilization, and its equipment includes anti-aircraft guns, anti-tank guns and armoured vehicles, although a lot of this is obsolete. The Ministry of the Interior has 10,500 men organized along military lines, while the transport police has a further 8,500 men.

Conclusion

The East German armed forces are probably trusted more highly by the USSR than any other non-Soviet Warsaw Pact forces, and thus receive Soviet equipment before any other members of the pact. Unlike Poland and Czechoslovakia, which produce armoured vehicles based on their own or Soviet designs, East Germany manufactures only small arms and ammunition. East Germany has for many years been sending training teams and military advisers to many parts of the world, and today has such groups in Algeria, Angola, Ethiopia, Guinea, Iraq, Libya, Mozambique, South Yemen and Syria.

The East German army has two surface-to-surface missile brigades each equipped with nine SS-1 'Scud-B' missiles on MAZ-543 eight-wheel transporters. 'Scud' has a range of up to 270 km (168 miles), and although in Soviet service they carry nuclear warheads the German 'Scuds' are likely to be conventionally armed.